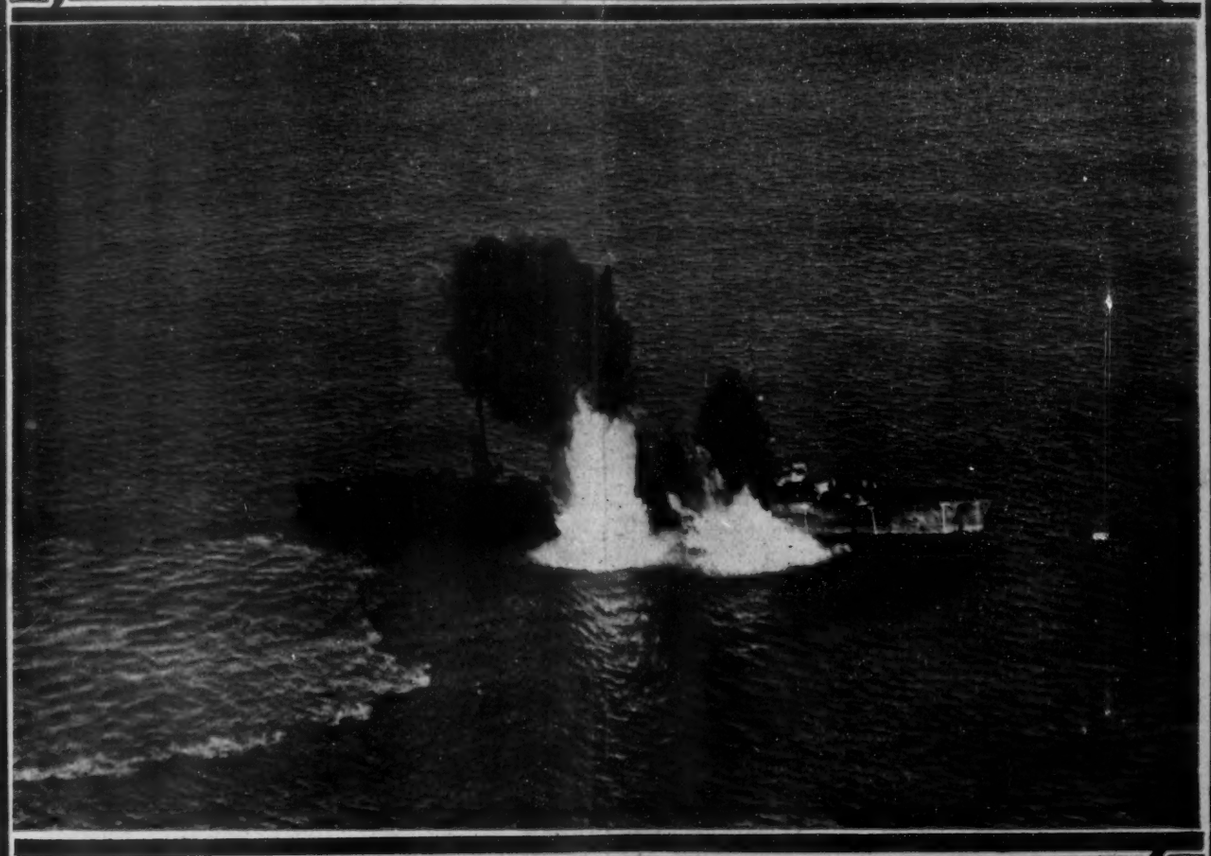
AUGUST 1, 1921 Issued Weekly PRICE 15 CENTS

FILE

AVIATION AND AIRCRAFT JOURNAL



Aircraft Bombs Hitting Alongside the Armored Cruiser Frankfurt

VOLUME XI
Number 5

Four Dollars a Year

SPECIAL FEATURES

HOW AIRCRAFT BOMBS SANK THE OSTFRIESLAND
WHAT GENERAL MITCHELL CLAIMED
COMMERCIAL AVIATION IN GERMANY
FIAT 10-PASSENGER AIRPLANE
THE PSYCHOLOGY OF PASSENGER CARRYING

RECEIVED
AUG 5 1921
FIELD OFFICERS SCHOOL
LANGLEY FIELD, VA.

THE GARDNER, MOFFAT CO., INC.
HIGHLAND, N. Y.
225 FOURTH AVENUE, NEW YORK

Entered as Second Class Matter, Nov. 22, 1920, at the Post Office at Highland, N. Y.
under Act of March 3, 1879.

SPEED

Does it mean anything to you to save time?

Why do you travel by motor-car rather than by horse and buggy? Why the telephone?

Have you in mind a city which you visit often? Some city, say, only two hundred miles distant on the map, but eight or ten hours away by smelly train that runs very seldom and always at just the wrong time. And the roads are always bad just when you want to go by automobile, having missed the train.

The next time such a trip makes you downright disgusted with life: - Imagine yourself "hopping over" in an hour or two, leaving when most convenient, and enjoying an invigorating sight-seeing trip.

Of course landing fields at both ends are required; but we must wake up to the fact that landing fields are infinitely cheaper, and are of proportionately much more direct advantage to the city in each case, than connecting rail - or auto - roads.

Air travel is coming. It is fundamental that any vehicle which permits material saving in time of transportation must eventually become an economic necessity.

Don't let other towns profit by air travel at your expense simply because your particular town will not prepare for it.

Vote for Your Municipal Landing Field

DAYTON WRIGHT COMPANY

DAYTON, OHIO

"The birthplace of the airplane"

DISTRIBUTORS OF THE PRODUCTS

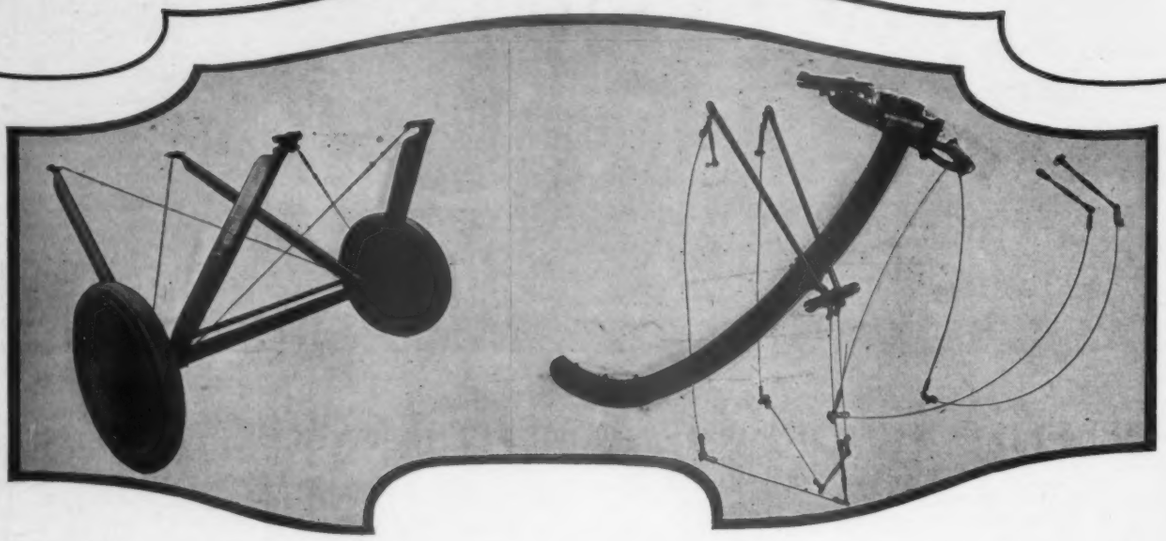
OF THE

CURTISS AEROPLANE & MOTOR CORPORATION:

THE STATE OF ILLINOIS, Branch Sales Office of the parent corp.	**Curtiss Aeroplane & Motor Corporation,** 30 North Michigan Ave., Chicago, Ills.
THE STATE OF MICHIGAN, EXCEPTING THE UPPER PENINSULA	**Thompson Airplane Company,** 2927 Woodward Ave., Detroit, Mich.
MOST OF THE STATE OF OHIO	**Floyd J. Logan,** 712 Superior Ave., N. W., Cleveland, Ohio.
THE STATE OF IOWA	**Curtiss Iowa Aircraft Corporation,** Fort Dodge, Iowa.
MOST OF THE STATE OF MISSOURI	**St. Louis-Curtiss Airplane Company,** 6426 Floyd Ave., St. Louis, Missouri.
THE STATE OF INDIANA	**Curtiss Indiana Company,** Kokomo, Indiana.
MOST OF ALABAMA AND GEORGIA	**Curtiss Bond Airplane Company,** Montgomery, Alabama.
THE STATES OF OREGON, WASHINGTON & IDAHO	**Oregon, Washington & Idaho Company,** 1209 Yeon Bldg., Portland, Ore.
THE STATES OF VIRGINIA & NORTH CAROLINA	**Lynchburg Air Service Co.,** 218 Wall Bldg., Lynchburg, Virginia.
THE STATES OF NEVADA AND NORTHERN CALIFORNIA	**Earl P. Cooper Airplane & Motor Corporation,** Sutter & Gough Sts., San Francisco, Calif.
THE STATE OF NEBRASKA	**Grand Island Aero Company,** Grand Island, Nebraska.
THE STATE OF WISCONSIN AND UPPER PENINSULA OF MICHIGAN	**Curtiss Wisconsin Airplane Company,** 330 Clinton St., Milwaukee, Wisc.
THE STATES OF NEW MEXICO, UTAH, WYOMING, AND COLORADO	**Curtiss Humphreys Airplane Company,** 1st Nat'l Bank Bldg., Denver, Colo.
THE STATES OF PENNSYLVANIA, MARYLAND, DELAWARE & SOUTHERN NEW JERSEY	**Curtiss Eastern Airplane Company,** 130 S. 15th St., Philadelphia, Penna.
THE STATES OF MINNESOTA, THE DAKOTAS, AND MONTANA	**Curtiss Northwest Airplane Company,** 707 Metropolitan Bank Bldg., Minneapolis, Minn.
THE STATE OF KANSAS AND PART OF MISSOURI	**Williams & Hill Airplane Company,** Arkansas City, Kansas.
THE NEW ENGLAND STATES	**Curtiss New England Airplane Company,** Garden City, Long Island, N. Y.
THE STATES OF TEXAS, OKLAHOMA, AND UNASSIGNED TERRITORIES	**Curtiss Aircraft Corporation.** Garden City, Long Island, N. Y. Love Field, Dallas, Texas.
ALL COUNTRIES OF SOUTH AMERICA	**C. W. Webster,** Curtiss Aeroplane & Motor Corporation, Garden City, Long Island, N. Y.

DEALERS

THE STATES OF MASSACHUSETTS AND RHODE ISLAND	**Lynnway Aerial Transportation Company,** 7 Central Square, Lynn, Mass.
PARTS OF THE CAROLINAS	**H. L. Morrow Company,** 540 S. Tryon St., Charlotte, N. C.



The LANDING GEAR and TAIL SKID, shown above, attached to an *AEROMARINE 39"B" HYDRO*, a number of which the Navy are offering for sale at **$1500.00** each, make a *fast flying, slow landing, reliable* aeroplane procurable at a very low cost; an *excellent* machine for *passenger carrying*. This Landing Gear & Tail Skid complete is being furnished by the *Aeromarine Plane and Motor Company*, Keyport, N.J., for **$500.00** F.O.B. Factory. *Prompt deliveries* can be made on a few sets of this equipment.

AEROMARINE PLANE & MOTOR CO.

TIMES BUILDING **NEW YORK**

AVIATION
AND
AIRCRAFT JOURNAL

AUGUST 1, 1921 VOL. XI. NO. 5

Member of the Audit Bureau of Circulations

INDEX TO CONTENTS

Editorials 127
Ostfriesland Sunk by 2000-lb. Bombs 128
Weather Information 132
What General Mitchell Claimed 133
Commercial Aviation in Germany 135
Civil Aviation Abroad 136
Commercial Aeronautics and War 137
The Lakehurst Naval Airship Station 138
Fiat 10-Passenger Airplane 139
Cadet Classes for Lighter-than-air Service 139
Proposed Air Mail Eervice 139
Psychology of Passenger Carrying 140
Civil Aviation in the British Dominions 140
New Aircraft Firm 141
A 4000-lb. Aircraft Bomb 141
Naval Air Chief Promoted 141
Pulitzer Air Race Canceled 141
Army and Navy Order for Lighter-than-air Craft .. 141
The Flight of the Cloudster 141
Trade Notes 142
Flexible Fuel Pipes 142
Educating the Public 142

THE GARDNER, MOFFAT COMPANY, Inc., *Publishers*
HIGHLAND, N. Y.
225 FOURTH AVENUE, NEW YORK

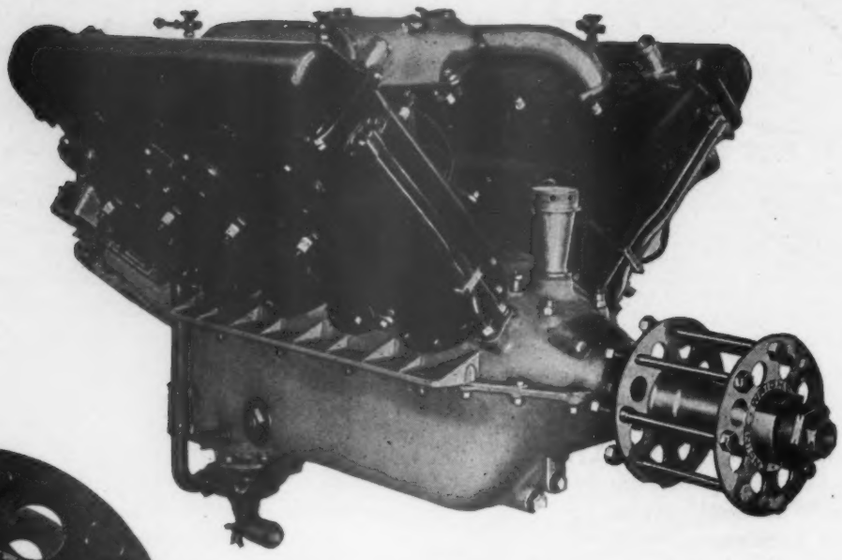
SUBSCRIPTION PRICE: FOUR DOLLARS PER YEAR. SINGLE COPIES FIFTEEN CENTS. CANADA, FIVE DOLLARS. FOREIGN, SIX DOLLARS A YEAR.

COPYRIGHT 1921, BY THE GARDNER, MOFFAT COMPANY, INC.
ISSUED EVERY MONDAY. FORMS CLOSE TEN DAYS PREVIOUSLY. ENTERED AS SECOND-CLASS MATTER NOV. 22, 1920, AT THE POST OFFICE AT HIGHLAND, N. Y., UNDER ACT OF MARCH 3, 1897.

THOMAS-MORSE AIRCRAFT CORPORATION

Thomas-Morse Training 2-Seater in flight over Ithaca, N. Y.

THOMAS-MORSE AIRCRAFT CORPORATION



The identification of Incomparable Service

FROM now on all WRIGHT engines will have this nameplate on the hub. This is a visible guarantee to all who fly with the engine that it was made by us in our own plant. This plate certifies that every ounce of material was critically examined, then machined by our own experienced men to exact gauge and carefully assembled. The nameplate guarantees the engine has passed our exacting running test requirements. While we are building aircraft engines this vigilance will never be relaxed.

The seven absolute requirements for aircraft engines are fulfilled in the two models of Wright engines now in production and being sold.

ENGINE REQUIREMENTS	RESULT IN PLANE OPERATION
1. *Lightness per horsepower*	Greater useful load, increased performance.
2. *High power*	Speed, climb, power reserve.
3. *Low fuel consumption*	Economy, long travel radius, increased useful load.
4. *Short overall length*	Increased manoeuvreability, compact installation.
5. *Interchangeable parts*	No long repair periods, economy, safety.
6. *Longevity*	Many WRIGHT engines built four years ago are still flying. Many have flown 1,000 hours and over. With th E-2 and H-2 engines incorporating changes based on actual experience from hundreds of our own engines, we advise commercial flyers to figure on ultimate life of 2,000 hours.
7. *Reliability*	The reliable WRIGHT engines safeguard the life of the flyers thru exacting quality and test requirements. Skill, experience and unrelaxing vigilance make these engines the most reliable in the world.

Compare the characteristics of these stock engines now in production with any engine built—foreign or domestic.

	WRIGHT E-2	WRIGHT H-2
Power at 2000 R.P.M.	220 H.P.	358 H.P.
" " 1800 "	200 H.P.	326 H.P.
Weight, dry with hub	485 lbs.	620 lbs.
Gas per H.P. hour	.48 lbs.	.5 lbs.
Overall length, including hub and mag.	4'-1⅛"	4'-3²⁵⁄₃₂"

NOTE:—The power given is the mean rated power, many individual engines give higher power and lower consumption.

WRIGHT AERONAUTICAL CORPORATION
PATERSON, N. J.

MINIMIZING REPAIRS

The new models of WRIGHT engines have thicker cylinder sleeve heads and increased cooling around the valves. This has stopped valve warping. From 200 to 300 hours may be expected without regrinding valves. A new device makes engine timing an easy operation.

WRIGHT
AERONAUTICAL ENGINES
STANDARD MOTIVE POWER FOR ALL AIRCRAFT

L. D. GARDNER, PRESIDENT
W. D. MOFFAT, VICE-PRESIDENT
W. I. SEAMAN, TREASURER
GEORGE NEWBOLD, BUSINESS MANAGER

AVIATION AND AIRCRAFT JOURNAL

LADISLAS D'ORCY, EDITOR
ALEXANDER KLEMIN
EDWARD P. WARNER
RALPH H. UPSON, CONTRIBUTING EDITORS

Vol. XI AUGUST 1, 1921 No. 5

"Don't Give up the Ship"—Protect It

ALL those whose interest in National Aviation is tempered by a broad conception of National Defense will hesitate to draw too definite conclusions from the recent bombing tests. As the Navy has repeatedly announced, the experiments had the prime purpose to secure information about naval ordnance. The incidental feature of the accuracy of bomb dropping could have been ascertained at any time without a 300-mile flight over water. The reliability of aircraft and engines has been known for a long time.

What then has been learned about naval ordnance from the tests off the Virginia Capes? The finding of nine unexploded bombs on the deck of the ex-Ostfriesland after the ship had been bombed by F-5-L flying boats, and the startling fact that eighteen out of forty bombs dropped during one test were "duds," will cause the public to question seriously the efficiency of the naval aircraft bombs. The percentage of "duds" in the case of Army bombs was practically negligible, none being recorded with the larger bombs. If nothing more were learned from the tests than the fact that naval aircraft bombs require a new fuse the tests would have been worth while.

It was rumored that some of the bombs used were of English manufacture, being war surplus equipment which the Navy was glad to dispose of. However that may be, to bring the Secretaries of War and Navy, and a distinguished party of Congressmen to see "dud" bombs dropped reflects little credit on the Navy's preparation. If nine out of thirteen hits on a ship failed to explode in war time the whole nation would demand an impartial investigation into such equipment.

While the bombing accuracy of both naval and Army fliers showed that they were well trained and that they could hit small targets both stationary and moving, it is to early to draw too positive conclusions as to the effects that could be obtained in an attack under service conditions on a well protected fleet. Given the only really effective defense against aircraft attack, pursuit aviation properly directed, the results might have been quite different. On the other hand again, the situation might have been totally changed in favor of the attacking air forces had the latter operated as they would in time of war—with gas bombs and torpedos in addition to and in advance of the fragmentation and demolition bombs that were actually employed in the tests. Had such a complete test been adequately simulated the whole country might have been appalled far beyond the startled surprise it now experiences.

So far as the tests having a bearing on the controversy over the continued value of the battleship as the backbone of a well proportioned fleet, there is a distinct danger that too much will be made of them on the assumption that the tests spell "the doom of the costly battleships." It is probable that any naval constructor would have admitted before the tests that direct hits by small sized bombs would have sunk unprotected seacraft. But the ex-Frankfurt and the ex-Ostfriesland went to the bottom not as the result of direct hits but of bombs dropped alongside of them. This contention of General Mitchell's was probably disputed more than any other, and its being borne out by the tests becomes the most important fact established by the bombing experiments.

Already the disarmament advocates are using the result of the bombing tests as another argument for a decrease in naval preparedness, which in their eyes means principally the scrapping of "costly battleships." Nothing could be more dangerous So long as this country is as defenseless in the air as it is today, and so long as no other country has a large air force, our navy is our first line of defense and the protector of our international relations. Aircraft advocates can do no greater service to National Defense than keeping these facts clearly in mind. Naval aviation should be placed in the hands of those who are willing and able to develop the aerial arm of the fleet untrammeled by tradition and unprejudiced by historical precedents.

The Navy faces today a more serious problem than most of its officers realize. It is not only the development of the various arms of Naval Aviation that is up for discussion; the bombs that sunk the Ostfriesland also open the question of making our battleships invulnerable against aircraft bombs and torpedoes—if it can be done.

Long Non-Stop Flights

THE recent attempt at a non-stop flight across the greater width of the United States—which was defeated by unfavorable atmospheric conditions—brings up the question whether such performances possess practical value. With all the respect due to the hardihood of pilots who undertake such flights, we cannot see what useful end is served by non-stop flights of several thousand miles.

Aviation has passed that stage of its development where spectacular long distance flights were needed to impress the public with the possibilities of mechanical flight. Today it is no longer necessary to demonstrate that a specially equipped airplane can, given favorable weather conditions, fly from the Atlantic to the Pacific without stopping en route. Such a flight, after all, is mainly a question of unusual endurance on the part of the pilot, or pilots. Granted that it also proves engine reliability if the flight succeesds, we have the reverse of the medal if the flight is defaulted through any cause however independent of the smooth running of the power plant. The not-yet-flying public naturally jumps to the conclusion that the flight failed because of the unreliability of the engine.

Lacking technical knowledge, the average reader does not know that in such flights the internal combustion engine is called upon to do work which would never be expected from an automobile or from a locomotive.

We believe that those engaged in aviation should seek to mould public opinion toward a better understanding of mechanical flight by emphasizing the features of dependability and safety rather than by putting up new "records."

Ostfriesland Sunk by 2000-lb. Aircraft Bombs

Martin Bombers of Army Air Service Sink the 23,000-ton Battleship in Fourteen Minutes

In the concluding phase of the bombing experiments conducted by the Army and Navy Air Services against warships of all types to determine the offensive power of aircraft the ex-German battleship Ostfriesland was sunk on July 21 by two 2000-lb. bombs dropped from Army Martin bombers. The dreadnaught had on the previous day been subjected to aerial bombardment with forty-one 230-lb. bombs and eleven 600-lb. bombs. Great damage was caused thereby to her superstructure, and some of her seams opened over night, for on the morning of the 21st the Ostfriesland was seen to have gone down two feet by the stern. The five 1100-lb. bombs which were dropped upon her on the morning of the second day of the bombing tests still further opened her seams, for she was at least ten feet down by the stern when the final test began. The 2,000-lb. bombs did their work quickly, for the 23,000-ton battleship went down fourteen minutes after the first of the two fatal bombs struck the water.

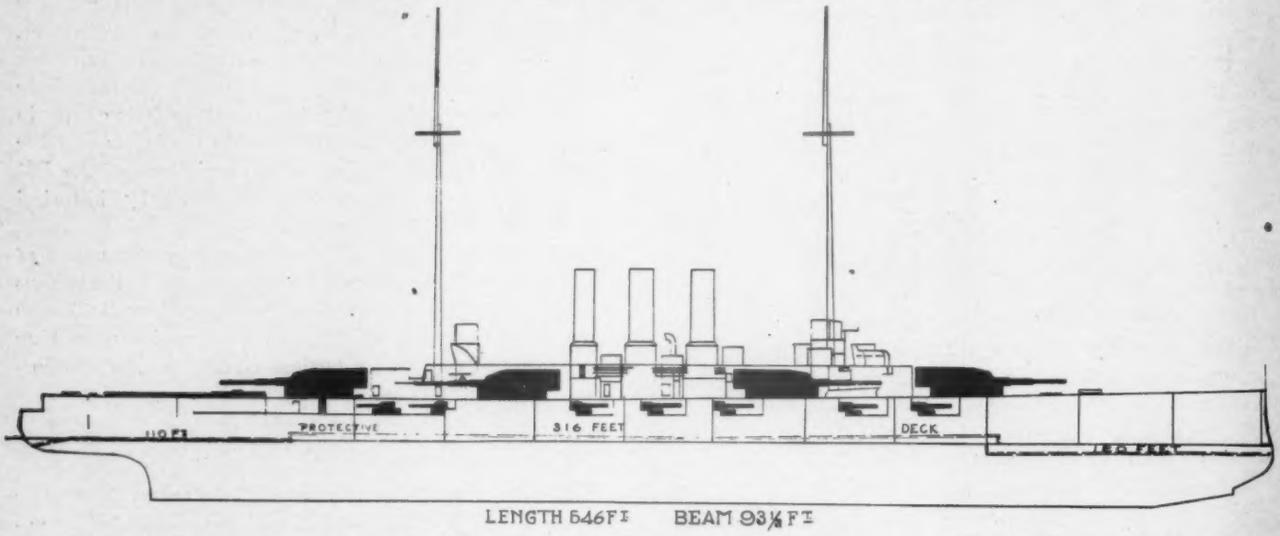
Thus was vindicated the contention of the students of aerial warfare who maintained that even the biggest and most powerful modern warship could be sunk by aircraft bombs provided the latter contained a sufficient quantity of explosive.

While the previous destruction by aircraft bombs of a submarine, a destroyer and an armored cruiser proved the vulnerability of unprotected or incompletely armored vessels to aerial attack, practically every naval officer doubted that a capital ship could be sunk by aircraft bombs. The proof to the affirmative which the destruction of the Ostfriesland affords is particularly instructive owing to the fact that the ship in question possessed unusually complete underwater protection. German naval design of the latter years has been noteworthy for the careful manner in which this question had been studied and solved. Admiral Sir John Jellicoe in his book "The Grand Fleet" comments on this point in connection with the battle of Jutland, where the British saw a number of German battleships in sinking condition and reported them as probable losses. The German report on the battle acknowledged a much smaller number of losses than that presumed by the British admiral, and the truth of their assertion was borne out after the armistice when the ships assumed to have been sunk were found in German harbors. The answer to the enigma was that the excellent underwater protection of the German battleships kept them afloat long enough to reach home waters.

In view of this point, which it is not immaterial to stress, the sinking of the Ostfriesland by means of two one-ton aircraft bombs, each containing 1000 lb. of TNT assumes particular significance. The keynote of comment in which groups of air officers and aircraft men indulged after the bombing tests was sounded by General Williams, Chief of Ordnance, U. S. Army, when he said:

"A Bomb was Fired Today . . ."

"A bomb was fired today that will be heard around the world. It is a heavier explosive charge than has ever been delivered against a battleship. Its sinking of the Ostfriesland means that the capital ship now faces a new menace that must be guarded against by every possible study and effort.



OUTBOARD PROFILE OF THE EX-GERMAN BATTLESHIP OSTFRIESLAND. PROTECTION: SIDE BELT AND TURRETS 12"; CONNING TOWER 13¾"; PROTECTIVE DECK ON SLOPE 3"

"The biggest mine exploded against battleships weighs 500 lb.; the biggest torpedo, 500 lb.; the heaviest depth charge, 300 lb., and the biggest charge ever fired from a big gun was 1800 lb., fired from the big Gathman experimental gun. Today we have seen a 2000-lb. bomb, half of whose weight represented TNT explosive, dropped alongside a battleship after having been carried by an airplane 100 miles from base out to sea. The thing today was the carrying of a mine of unprecedented size out that distance in land planes and putting it down successfully. Stop and think what that all means."

Air Commodore Charlton, British air attache at Washington, D. C. echoed General Williams' views by saying:

"My only comment is that this shot will ring around the world. That's been said before, but it's true."

First Day of Bombing

The bombing tests with the Ostfriesland began on July 20, when the vessel, which was anchored some 70 miles off the Virginia Capes, was subjected to aerial attacks first with 230-lb. bombs and then with 600-lb. bombs. The lighter bombs were used by naval F-5-L seaplanes and Marine Corps DH-4B land machines, while the Army, using Martin bombers, employed the 600-lb. bombs. General Mitchell, believing that the information secured in the bombing of the Frankfurt had sufficiently shown the damage that could be done by lighter bombs, withdrew from the light bombing tests of the Ostfriesland. Altogether forty-one 230-lb. naval bombs and eleven 600-lb. Army bombs were dropped on the target ship. There

were scored thirteen direct hits, but nine of these were "duds" which failed to explode on hitting the ship. The naval bombs had a particularly large percentage of duds.

The attack was opened at 1.30 p.m. by a division of five Marine Corps DH-4 land machines which, after dropping a smoke bomb for ranging purposes, released nine 230-lb. bombs in four salvoes. One direct hit was scored aft of the smoke-stacks, where damage was done to the deckworks. Five bombs were duds.

At 2.05 p.m. the Second Division of naval F-5-L seaplanes arrived on the scene and dropped seven 230-lb. bombs, one of which hit aft of the funnels doing local damage. Five of the bombs dropped were duds. At 2.32 o'clock the Ostfriesland took a decided list to port, apparently as the result of the direct hit scored by one of the F-5-L seaplanes. The Fourth Division of F-5-L's then attacked the target and dropped eleven more 230-lb. bombs with varying success. Many of these were duds, but two bombs, hitting off the stern would probably have put the steering gear out of commission or damaged the propellers.

At 2.40 p.m. the Army Martin bombers arrived overhead and were kept in the air waiting for fifty minutes while the aircraft tender Shawmut, carrying the Observers' Board, drew alongside the Ostfriesland and examined the effect of the bombs that hit the vessel. The verdict was that local damage had been caused, but that the vessel was not seriously damaged.

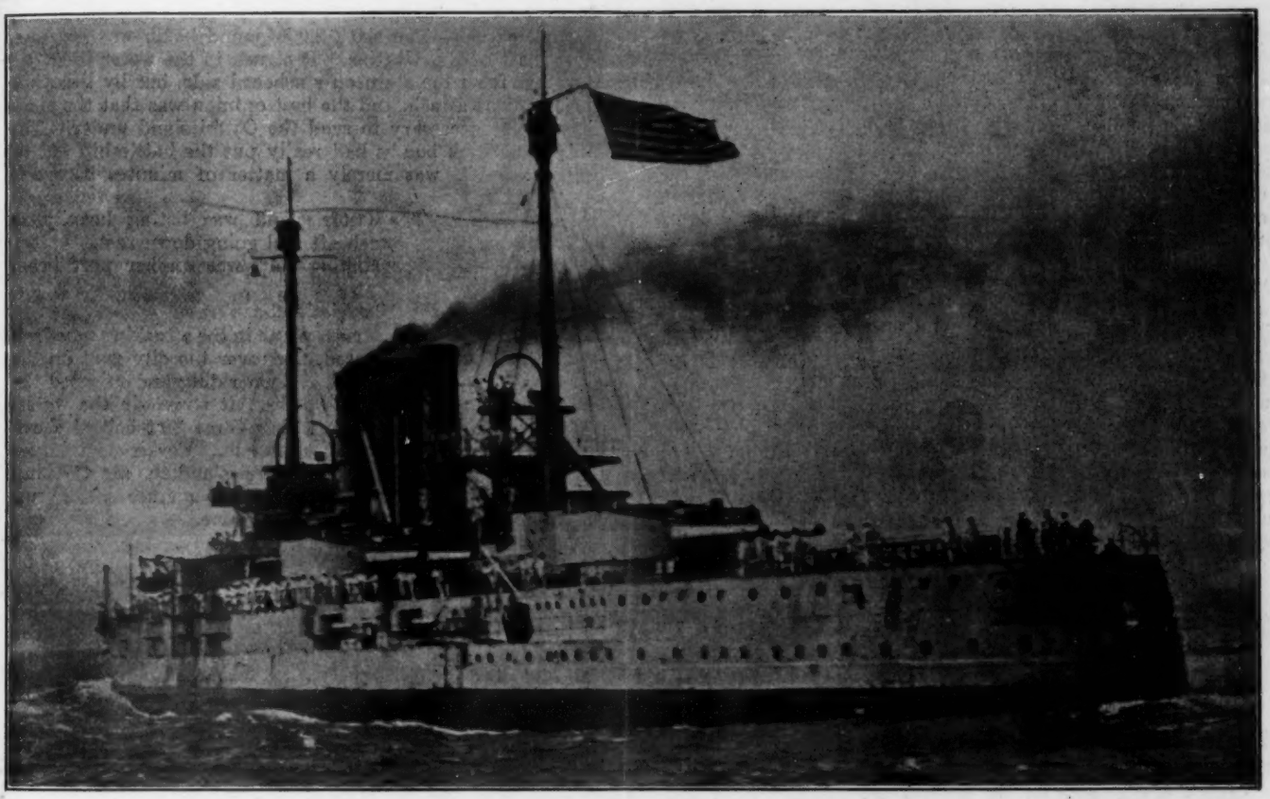
At 3.43 the bombing tests were resumed when the Martin bombers dropped eleven 600-lb. bombs. By then it had become evident to General Mitchell that the small bombs employed could not pierce the armored deck of the Ostfriesland and the Army fliers were therefore given orders to drop their bombs near enough to the ship to cause her seams to open through the underwater explosions. This the Martin bombers proceeded to do with great accuracy, for they placed three bombs just off the bow and two off the stern, and made one direct hit.

While the Martin bombers were dropping their bombs another division of F-5-L flying boats appeared and dropped a dozen 230-lb. bombs, scoring two direct hits while several bombs dropped right off the bow or stern. Nevertheless the Ostfriesland did not appear to be more than locally damaged when the smoke drew away from the last bomb, which hit the stern at 4.27. In this series of bombs there was again a number of duds.

Although the observers' board which examined the Ostfriesland after the bombing announced that there had been no serious damage to the vessel, some of the bombs which exploded close to her bow and stern eventually proved more effective than had been thought at first. The following morning, July 21, the Ostfriesland was found to have gone down two feet by her stern during the night and examination showed that there had developed opening in the underwater seams, through which the ship was slowly taking in water. The naval officers stated that had the pumps been working this water could have been taken care of easily.

The Second Day of Bombing

The second series of bombing tests against the Ostfriesland comprised two phases: an early morning attack by Army Martin bombers dropping 1100-lb. bombs, and a midday attack in which six Martin bombers and one Handley-Page of the Army Air Service dropped 2000-lb. bombs and finally sank the ship.



EX-GERMAN BATTLESHIP OSTFRIESLAND SUNK BY ARMY MARTIN BOMBERS ON JULY 21

Considerable damage to the superstructure of the ship was done in the morning attack, when the Army Martin bombers scored three direct hits out of five bombs dropped. This accuracy of five, 60 per cent, was the best in all the tests. The five machines arrived on the scene at 8.23 a.m. and seven minutes later four small range-finding bombs were let loose. At 8.35 the Martins, in single column, circled the target and dropped five of the twelve 1100-lb. bombs which they carried. Having scored three direct hits, the Army fliers were ordered to cease bombing at 8.50 by the Observers' Board, which ruled that enough direct hits had been made to warrant calling off the rest of the 1100-lb. bombing test. The Martin bombers thereupon returned to Langley Field, dropping the remainder of their bombs in the sea to lessen their flying weight.

The first direct hit with the 1100-lb. bomb was on the starboard side of the forecastle deck and took a large hole out of her side. The second bomb fell in the water 150 yd. off the port bow, but the third bomb hit the ship on the starboard near

the aft funnel and scattered flying wreckage hundreds of feet in the air. The fourth bomb scored a direct hit in the same part of the ship, while the fifth bomb fell off the starboard beam some 70 yd. in the water. All three direct hits caused serious damage to the deck equipment and superstructure, but the Naval Board declared that none of them would have sunk the vessel as none had pierced the armored deck.

The second hit in particular did considerable damage to the deck where it fell, while the third 1100-lb. bomb broke away part of the after structure just aft of the third funnel and would have disabled the after fireroom had it been in boiler service. The contention of the Naval Board was that as these hits had not pierced the armored deck, they could not do any damage to the steering gears, boilers, pumps or machinery, so that the water taken in so far might have been pumped out and the Ostfriesland might have been able to reach port.

The second phase of this day's bombing, in which the former German battleship was subjected to the attack of 2000-lb. bombs however dispelled any belief that may have been entertained as to the invulnerability of capital ships against aircraft bombs of sufficient size. it is generally believed by Army and naval ordnance men present at the tests that two of the six 2000-lb. bombs were responsible for sinking the Ostfriesland. These were the fourth and fifth bombs, dropped, one of which fell in the sea close in along the portside of the quarterdeck and which fairly rocked and lifted the 23,000-ton battleship, the other bomb falling close in on the port side of the stern.

Almost immediately after the fifth bomb was dropped the Ostfriesland was going down astern and her water line was rising on the forward starboard quarter of the target. By the time the sixth bomb was dropped the wounded dreadnought was sinking rapidly by the stern; then her afterdecks went under, while the bow stuck out in the air a distance equal to twice that from the water line upward. The ship in four more minutes was listing heavily to port. She rolled over quickly on her port beam ends and turned turtle to port, exposing two-thirds of her entire bottom from mainmast forward, glistening with sea water and barnacles. Having thus turned turtle the great hulk slid down stern first toward the ocean bottom.

Detailed Record of Final Bombing

Following is the detailed record of the bombing operation which sank the Ostfriesland:

10:52 A.M.—Captain A. W. Johnson, U. S. N., commanding the Atlantic Fleet air force stationed on the observing ship Shawmut 62 miles east of Cape Charles, radiographed an order to the Langley field flying base, 97½ miles distant, to send out its force of Martin bombers carrying 2,000-pound bombs.

10:58 A.M.—Major T. D. Milling, commanding the Langley Field base, radiographed his reply that the six Martin bombers and one Handley Page were starting from base for the target at sea.

12:05 o'clock—The Army Martins and Handley Page flying in V formation were sighted arriving at the target area.

12:15 o'clock—After shifting from V formation to a column line for attack the leading Martin bomber dropped a small bomb as a range finger which fell 150 feet ahead of the target's bow.

12:19 o'clock—The next army Martin dropped a 2,000-pound bomb which hit the water close in on the starboard bow of the target, making a terrific underwater explosion.

12:19 o'clock—The next army Martin dropped a 2,000-pound bomb which hit the water 300 feet ahead of the target's bow.

12:21 o'clock—The next army Martin dropped a small range-finding subcalibre bomb which fell 100 feet ahead of the Ostfriesland's starboard bow.

12:24 o'clock— The third 2,000-pound bomb was dropped by the next Martin bomber. It scored a direct hit, falling on deck in the forward point of the target's bow in what sailors call the "eyes of the ship," exploding with a terrific burst of fire and smoke and tearing a great hole out of the starboard side of the forecastle.

12:26 o'clock—The fourth 2,000-pound bomb that was dropped by the next Martin bomber in the attacking column went into the water close in on the port side of the target abreast of the mainmast behind the funnels, fairly lifting the hulk upward and throwing a heavy fall of water on the deck, which flowed like a Niagara over the starboard side.

12:27 o'clock—The fifth 2,000-pound bomb dropped by the next Martin bomber, and the one that began to put the ship under, fell a little further back in the water near the stern of the Ostfriesland on the port quarter side, exploding with terrific effect, sending up a great sheet of water that fell clear across the quarterdeck. Immediately after this bomb dropped the nose of the target rose, and the Ostfriesland started sinking fast by the stern. The two big guns in the after turret of the ship which had been thrown out of alignment by one of the morning shots and which were clearly silhouetted before this shot disappeared after the bomb hit the water.

12:28 o'clock—The Ostfriesland was sinking rapidly by the stern.

12:32 o'clock—The sixth 2,000-pound bomb was dropped by the last of the Martins. It struck in the water less than fifty feet from the stern on starboard side, but by this time the stern was awash, and the best opinion was that the sixth hit was not necessary to send the Ostfriesland under. The fourth and fifth bombs had really put the battleship out of business and it was merely a matter of minutes before it was sunk.

12:34 o'clock—The Ostfriesland was listing heavily to port with her decks awash aft and going down fast.

12:39 o'clock—The sinking ship was on her port beam ends.

12:40 o'clock—The Ostfriesland sank.

12:41 o'clock—The seventh plane in the attacking squadron the only Handley Page used, flew over the oily spot on the ocean where the battleship had been riding and released the seventh of the 2,000-pound bombs. It struck in the water, penetrated deeply and burst with a force that helped shove the Ostfriesland faster to the bottom. For some minutes after the disappearance of the Ostfriesland the air escaping from her compartments, rising to the surface kicked up white movements of water over her grave.

General Mitchell Congratulated

With the sinking of the target, General Mitchell, who was flying over the target area, swung his plane down and sped close around the transport Henderson, followed by another Army de Haviland. The "gallery" of Generals, Senators, Representatives, foreign military attachés and others on board the Henderson waved and shouted their congratulations to General Mitchell as he spun around the transport.

Major General Charles T. Menoher, Chief of Air Service, was among those on the Henderson. He at once sent this radio message to General Mitchell, who caught it in the air:

"Congratulations to you and the entire aircraft brigade on your brilliant performance today."

General Mitchell has flown more than 2,000 miles this week in connection with the Frankfurt and Ostfriesland tests. He wanted to see all the damage done by the bombs and made his own inspection of the decks of both vessels. He piloted the machine, and he had as passenger an Army officer who recorded all observations. On the basis of these studies, as the different phases of the tests proceeded, the instructions to the army bombers in the later operations were formed.

Every bombing machine in all these tests has had to fly a minimum of 200 miles from base to target and return. None of the Army planes was fitted with a pontoon. Accordingly none was able to land at sea.

General Menoher's Opinion

Major General Menoher expressed the following opinion in connection with the sinking of the Ostfriesland:

"A cold material fact has been demonstrated. That fact is that the battleship can be sunk by the aerial bomb. That's the real lesson of this affair. I haven't changed my mind at all as a result of these bombing manoeuvers. I have always contended that the bomb did constitute a very grave menace to the capital ship and that extraordinary precautions had to be taken to meet the menace. That's the whole story. I never

What General Mitchell Claimed

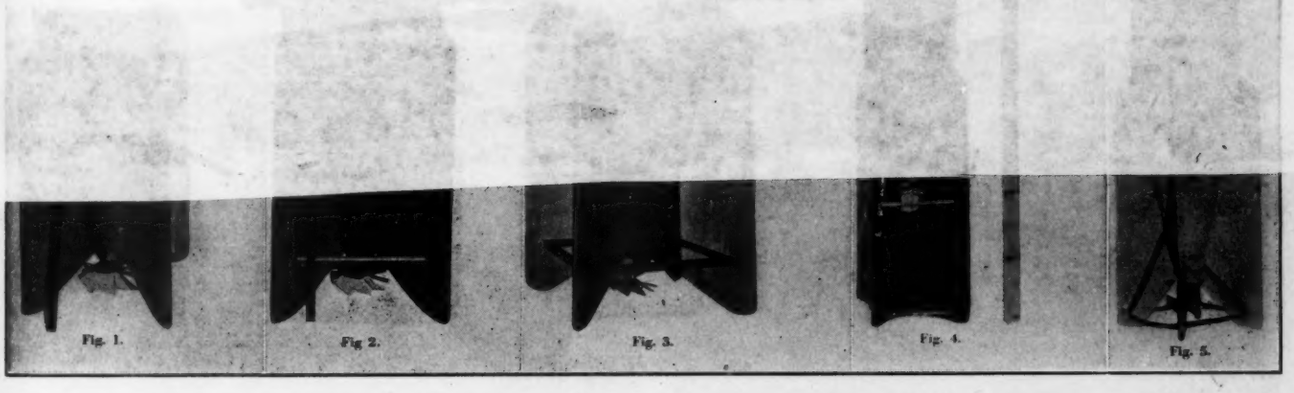


Fig. 1. Fig. 2. Fig. 3. Fig. 4. Fig. 5.

AIRCRAFT BOMBS SUPPLIED BY THE ARMY ORDNANCE DEPARTMENT FOR THE BOMBING EXPERIMENTS WITH WARSHIPS OFF THE VIRGINIA CAPES

that they have been able to do all this without a single casualty is both important and exceedingly gratifying.

"It shows good training and discipline and demonstrates above all things the ability of the Liberty motor. The Martins as well as the De Havilands which delivered the lighter bombs all used the Liberty motors for these long journeys seaward. It is gratifying to know that we can have as reliable a bomb and fuse as has been used in these tests and turned out by the ordnance branch of the army."

The Need of Aircraft Carriers

Captain W. A. Moffat, Director of Naval Aeronautics, was asked his opinion.

"The lesson," he replied, "is that we must put planes on batt'eships and get aircraft carriers quickly. I regret that Congress in the new Naval bill failed to provide for airplane carriers. That is now the great need. We must now get them and quickly. We must put aviators on all our battleships to enable them to be ready to ward off air bombing attacks in the event of war, pending the time we get airplane carriers."

Both Army and Navy officers agreed with Captain Moffat that the United services and Congress must now concentrate on getting authorization for aircraft carriers. Captain Moffat thinks eight is the minimum number of aircraft carriers we should have and that they should be specially designed and built to order. The Navy Department recommended only two carriers in its estimates. The House struck out the appropriation.

used in the preparatory attacks on the U-117 and the G-102.

All these bombs with the exception of the armor piercing type are equipped with both nose and tail fuses, each of which may be arranged to give instantaneous explosion on impact with the target or delay action. During the bombing tests a delay of one-half second was generally used. The fuses are all of the arming vane type, which depends on the rush of air past them in falling to arm the bomb.

Following are the characteristics of the demolition and armor piercing bombs developed by the Ordnance Department for the Army Air Service.

300 LB. DEMOLITION BOMB (FIG. 1)

Approximate Weight	300 lb.
Explosion Charge	50 per cent
Overall Length	4 ft. 1 in.
Maximum Diameter	12.2 in.

This bomb is equipped with nose and tail fuses capable of instantaneous or delay action.

The nose casing is thickened in order to withstand impact against the ground, substantial buildings or vessels not provided with deck armor.

The rear casing is of thin metal designed to prevent the disruption of the charge before detonation takes place.

There are two suspension lugs on the body of the bomb 14 in. apart by means of which the projectile is carried.

Four flat fins 60 deg. apart give the bomb stability in flight."

Ostfriesland Sunk by 2000-lb. Aircraft Bombs

Martin Bombers of Army Air Service Sink the 23,000-ton Battleship in Fourteen Minutes

In the concluding phase of the bombing experiments conducted by the Army and Navy Air Services against warships of all types to determine the offensive power of aircraft the ex-German battleship Ostfriesland was sunk on July 21 by two 2000-lb. bombs dropped from Army Martin bombers. The dreadnaught had on the previous day been subjected to aerial bombardment with forty-one 230-lb. bombs and eleven 600-lb. bombs. Great damage was caused thereby to her superstructure, and some of her seams opened over night, for on the morning of the 21st the Ostfriesland was seen to have gone down two feet by the stern. The five 1100-lb. bombs which were dropped upon her on the morning of the second day of the bombing tests still further opened her seams, for she was at least ten feet down by the stern when the final test began. The 2,000-lb. bombs did their work quickly, for the 23,000-ton battleship went down fourteen minutes after the first of the two fatal bombs struck the water.

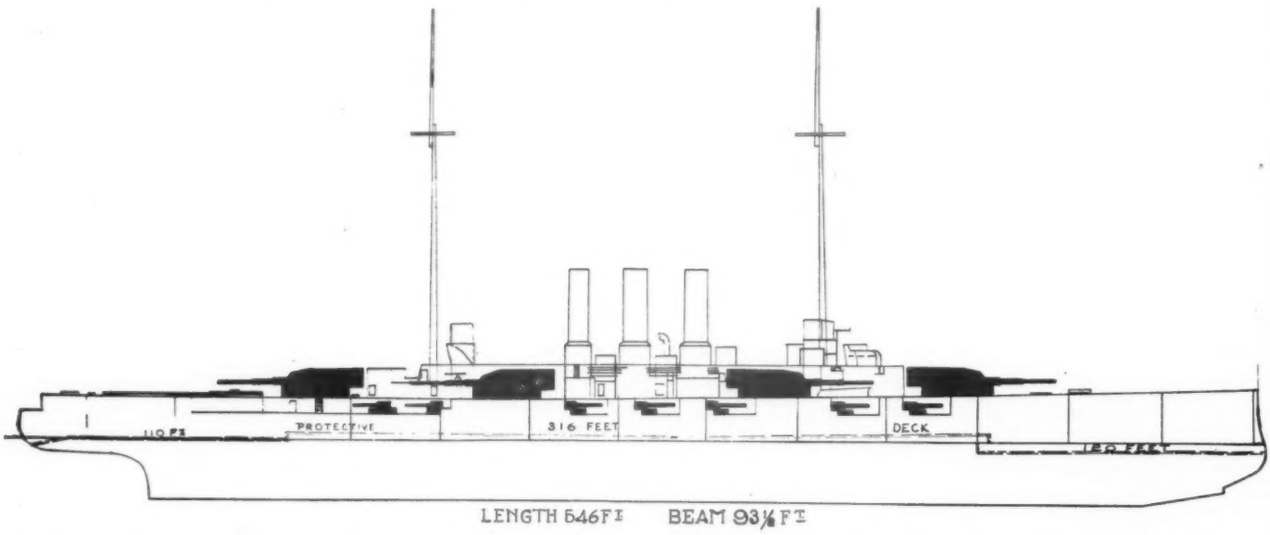
Thus was vindicated the contention of the students of aerial warfare who maintained that even the biggest and most powerful modern warship could be sunk by aircraft bombs provided the latter contained a sufficient quantity of explosive.

While the previous destruction by aircraft bombs of a submarine, a destroyer and an armored cruiser proved the vulnerability of unprotected or incompletely armored vessels to aerial attack, practically every naval officer doubted that a capital ship could be sunk by aircraft bombs. The proof to the affirmative which the destruction of the Ostfriesland affords is particularly instructive owing to the fact that the ship in question possessed unusually complete underwater protection. German naval design of the latter years has been noteworthy for the careful manner in which this question had been studied and solved. Admiral Sir John Jellicoe in his book "The Grand Fleet" comments on this point in connection with the battle of Jutland, where the British saw a number of German battleships in sinking condition and reported them as probable losses. The German report on the battle acknowledged a much smaller number of losses than that presumed by the British admiral, and the truth of their assertion was borne out after the armistice when the ships assumed to have been sunk were found in German harbors. The answer to the enigma was that the excellent underwater protection of the German battleships kept them afloat long enough to reach home waters.

In view of this point, which it is not immaterial to stress, the sinking of the Ostfriesland by means of two one-ton aircraft bombs, each containing 1000 lb. of TNT assumes particular significance. The keynote of comment in which groups of air officers and aircraft men indulged after the bombing tests was sounded by General Williams, Chief of Ordnance, U. S. Army, when he said:

"A Bomb was Fired Today . . ."

"A bomb was fired today that will be heard around the world. It is a heavier explosive charge than has ever been delivered against a battleship. Its sinking of the Ostfriesland means that the capital ship now faces a new menace that must be guarded against by every possible study and effort.



OUTBOARD PROFILE OF THE EX-GERMAN BATTLESHIP OSTFRIESLAND. PROTECTION: SIDE BELT AND TURRETS 12"; CONNING TOWER 13¾"; PROTECTIVE DECK ON SLOPE 3"

"The biggest mine exploded against battleships weighs 500 lb.; the biggest torpedo, 500 lb.; the heaviest depth charge, 300 lb., and the biggest charge ever fired from a big gun was 1800 lb., fired from the big Gathman experimental gun. Today we have seen a 2000-lb. bomb, half of whose weight represented TNT explosive, dropped alongside a battleship after having been carried by an airplane 100 miles from base out to sea. The thing today was the carrying of a mine of unprecedented size out that distance in land planes and putting it down successfully. Stop and think what that all means."

Air Commodore Charlton, British air attache at Washington, D. C. echoed General Williams' views by saying:

"My only comment is that this shot will ring around the world. That's been said before, but it's true."

First Day of Bombing

The bombing tests with the Ostfriesland began on July 20, when the vessel, which was anchored some 70 miles off the Virginia Capes, was subjected to aerial attacks first with 230-lb. bombs and then with 600-lb. bombs. The lighter bombs were used by naval F-5-L seaplanes and Marine Corps DH-4B land machines, while the Army, using Martin bombers, employed the 600-lb. bombs. General Mitchell, believing that the information secured in the bombing of the Frankfurt had sufficiently shown the damage that could be done by lighter bombs, withdrew from the light bombing tests of the Ostfriesland. Altogether forty-one 230-lb. naval bombs and eleven 600-lb. Army bombs were dropped on the target ship. There

were scored thirteen direct hits, but nine of these were "duds" which failed to explode on hitting the ship. The naval bombs had a particularly large percentage of duds.

The attack was opened at 1.30 p.m. by a division of five Marine Corps DH-4 land machines which, after dropping a smoke bomb for ranging purposes, released nine 230-lb. bombs in four salvoes. One direct hit was scored aft of the smoke-stacks, where damage was done to the deckworks. Five bombs were duds.

At 2.05 p.m. the Second Division of naval F-5-L seaplanes arrived on the scene and dropped seven 230-lb. bombs, one of which hit aft of the funnels doing local damage. Five of the bombs dropped were duds. At 2.32 o'clock the Ostfriesland took a decided list to port, apparently as the result of the direct hit scored by one of the F-5-L seaplanes. The Fourth Division of F-5-L's then attacked the target and dropped eleven more 230-lb. bombs with varying success. Many of these were duds, but two bombs, hitting off the stern would probably have put the steering gear out of commission or damaged the propellers.

At 2.40 p.m. the Army Martin bombers arrived overhead and were kept in the air waiting for fifty minutes while the aircraft tender Shawmut, carrying the Observers' Board, drew alongside the Ostfriesland and examined the effect of the bombs that hit the vessel. The verdict was that local damage had been caused, but that the vessel was not seriously damaged.

At 3.43 the bombing tests were resumed when the Martin bombers dropped eleven 600-lb. bombs. By then it had become evident to General Mitchell that the small bombs employed could not pierce the armored deck of the Ostfriesland and the Army fliers were therefore given orders to drop their bombs near enough to the ship to cause her seams to open through the underwater explosions. This the Martin bombers proceeded to do with great accuracy, for they placed three bombs just off the bow and two off the stern, and made one direct hit.

While the Martin bombers were dropping their bombs another division of F-5-L flying boats appeared and dropped a dozen 230-lb. bombs, scoring two direct hits while several bombs dropped right off the bow or stern. Nevertheless the Ostfriesland did not appear to be more than locally damaged when the smoke drew away from the last bomb, which hit the stern at 4.27. In this series of bombs there was again a number of duds.

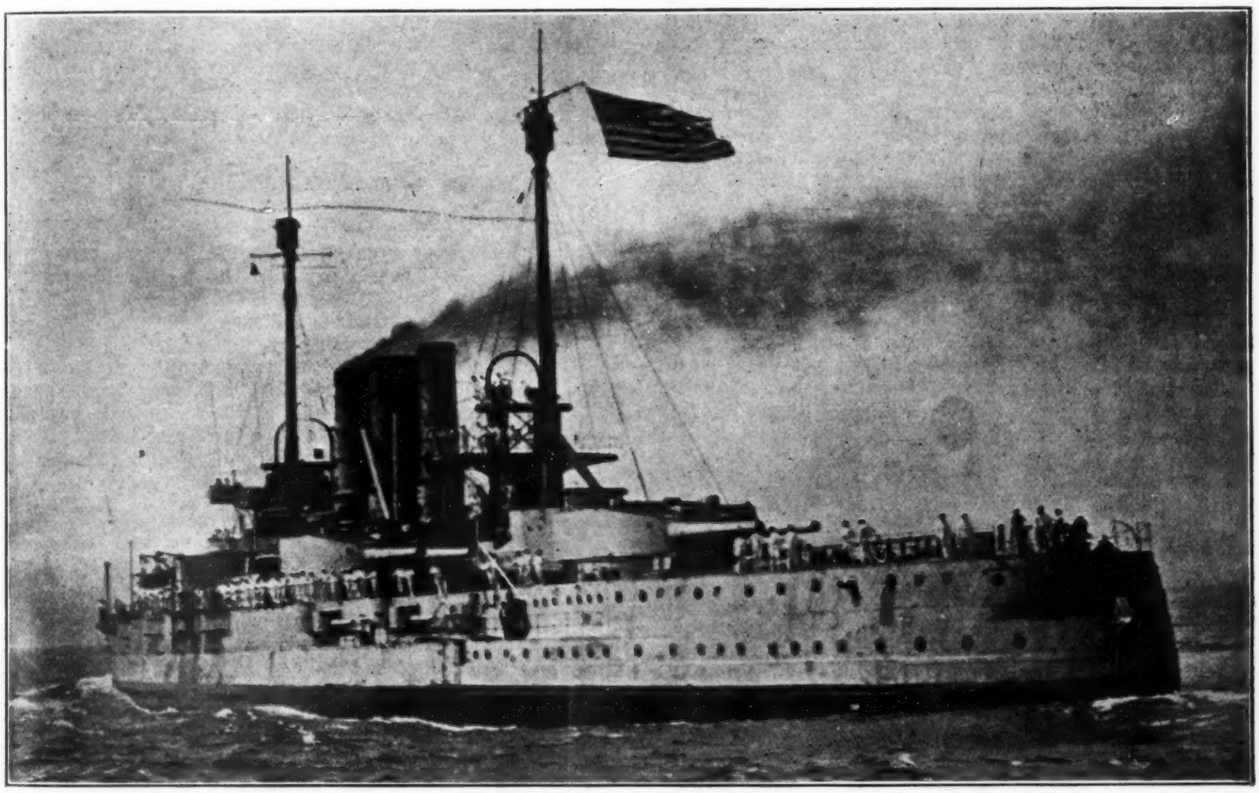
Although the observers' board which examined the Ostfriesland after the bombing announced that there had been no serious damage to the vessel, some of the bombs which exploded close to her bow and stern eventually proved more effective than had been thought at first. The following morning, July 21, the Ostfriesland was found to have gone down two feet by her stern during the night and examination showed that there had developed opening in the underwater seams, through which the ship was slowly taking in water. The naval officers stated that had the pumps been working this water could have been taken care of easily.

The Second Day of Bombing

The second series of bombing tests against the Ostfriesland comprised two phases: an early morning attack by Army Martin bombers dropping 1100-lb. bombs, and a midday attack in which six Martin bombers and one Handley-Page of the Army Air Service dropped 2000-lb. bombs and finally sank the ship.

Considerable damage to the superstructure of the ship was done in the morning attack, when the Army Martin bombers scored three direct hits out of five bombs dropped. This accuracy of five, 60 per cent, was the best in all the tests. The five machines arrived on the scene at 8.23 a.m. and seven minutes later four small range-finding bombs were let loose. At 8.35 the Martins, in single column, circled the target and dropped five of the twelve 1100-lb. bombs which they carried. Having scored three direct hits, the Army fliers were ordered to cease bombing at 8.50 by the Observers' Board, which ruled that enough direct hits had been made to warrant calling off the rest of the 1100-lb. bombing test. The Martin bombers thereupon returned to Langley Field, dropping the remainder of their bombs in the sea to lessen their flying weight.

The first direct hit with the 1100-lb. bomb was on the starboard side of the forecastle deck and took a large hole out of her side. The second bomb fell in the water 150 yd. off the port bow, but the third bomb hit the ship on the starboard near



Ex-German Battleship Ostfriesland Sunk by Army Martin Bombers on July 21

the aft funnel and scattered flying wreckage hundreds of feet in the air. The fourth bomb scored a direct hit in the same part of the ship, while the fifth bomb fell off the starboard beam some 70 yd. in the water. All three direct hits caused serious damage to the deck equipment and superstructure, but the Naval Board declared that none of them would have sunk the vessel as none had pierced the armored deck.

The second hit in particular did considerable damage to the deck where it fell, while the third 1100-lb. bomb broke away part of the after structure just aft of the third funnel and would have disabled the after fireroom had it been in boiler service. The contention of the Naval Board was that as these hits had not pierced the armored deck, they could not do any damage to the steering gears, boilers, pumps or machinery, so that the water taken in so far might have been pumped out and the Ostfriesland might have been able to reach port.

The second phase of this day's bombing, in which the former German battleship was subjected to the attack of 2000-lb. bombs however dispelled any belief that may have been entertained as to the invulnerability of capital ships against aircraft bombs of sufficient size. it is generally believed by Army and naval ordnance men present at the tests that two of the six 2000-lb. bombs were responsible for sinking the Ostfriesland. These were the fourth and fifth bombs, dropped, one of which fell in the sea close in along the portside of the quarterdeck and which fairly rocked and lifted the 23,000-ton battleship, the other bomb falling close in on the port side of the stern.

Almost immediately after the fifth bomb was dropped the Ostfriesland was going down astern and her water line was rising on the forward starboard quarter of the target. By the time the sixth bomb was dropped the wounded dreadnought was sinking rapidly by the stern; then her afterdecks went under, while the bow stuck out in the air a distance equal to twice that from the water line upward. The ship in four more minutes was listing heavily to port. She rolled over quickly on her port beam ends and turned turtle to port, exposing two-thirds of her entire bottom from mainmast forward, glistening with sea water and barnacles. Having thus turned turtle the great hulk slid down stern first toward the ocean bottom.

Detailed Record of Final Bombing

Following is the detailed record of the bombing operation which sank the Ostfriesland:

10:52 A.M.—Captain A. W. Johnson, U. S. N., commanding the Atlantic Fleet air force stationed on the observing ship Shawmut 62 miles east of Cape Charles, radiographed an order to the Langley field flying base, 97½ miles distant, to send out its force of Martin bombers carrying 2,000-pound bombs.

10:58 A.M.—Major T. D. Milling, commanding the Langley Field base, radiographed his reply that the six Martin bombers and one Handley Page were starting from base for the target at sea.

12:05 o'clock—The Army Martins and Handley Page flying in V formation were sighted arriving at the target area.

12:15 o'clock—After shifting from V formation to a column line for attack the leading Martin bomber dropped a small bomb as a range finger which fell 150 feet ahead of the target's bow.

12:19 o'clock—The next army Martin dropped a 2,000-pound bomb which hit the water close in on the starboard bow of the target, making a terrific underwater explosion.

12:19 o'clock—The next army Martin dropped a 2,000-pound bomb which hit the water 300 feet ahead of the target's bow.

12:21 o'clock—The next army Martin dropped a small range-finding subcalibre bomb which fell 100 feet ahead of the Ostfriesland's starboard bow.

12:24 o'clock— The third 2,000-pound bomb was dropped by the next Martin bomber. It scored a direct hit, falling on deck in the forward point of the target's bow in what sailors call the "eyes of the ship," exploding with a terrific burst of fire and smoke and tearing a great hole out of the starboard side of the forecastle.

12:26 o'clock—The fourth 2,000-pound bomb that was dropped by the next Martin bomber in the attacking column went into the water close in on the port side of the target abreast of the mainmast behind the funnels, fairly lifting the hulk upward and throwing a heavy fall of water on the deck, which flowed like a Niagara over the starboard side.

12:27 o'clock—The fifth 2,000-pound bomb dropped by the next Martin bomber, and the one that began to put the ship under, fell a little further back in the water near the stern of the Ostfriesland on the port quarter side, exploding with terrific effect, sending up a great sheet of water that fell clear across the quarterdeck. Immediately after this bomb dropped the nose of the target rose, and the Ostfriesland started sinking fast by the stern. The two big guns in the after turret of the ship which had been thrown out of alignment by one of the morning shots and which were clearly silhouetted before this shot disappeared after the bomb hit the water.

12:28 o'clock—The Ostfriesland was sinking rapidly by the stern.

12:32 o'clock—The sixth 2,000-pound bomb was dropped by the last of the Martins. It struck in the water less than fifty feet from the stern on starboard side, but by this time the stern was awash, and the best opinion was that the sixth hit was not necessary to send the Ostfriesland under. The fourth and fifth bombs had really put the battleship out of business and it was merely a matter of minutes before it was sunk.

12:34 o'clock—The Ostfriesland was listing heavily to port with her decks awash aft and going down fast.

12:39 o'clock—The sinking ship was on her port beam ends.

12:40 o'clock—The Ostfriesland sank.

12:41 o'clock—The seventh plane in the attacking squadron the only Handley Page used, flew over the oily spot on the ocean where the battleship had been riding and released the seventh of the 2,000-pound bombs. It struck in the water, penetrated deeply and burst with a force that helped shove the Ostfriesland faster to the bottom. For some minutes after the disappearance of the Ostfriesland the air escaping from her compartments, rising to the surface kicked up white movements of water over her grave.

General Mitchell Congratulated

With the sinking of the target, General Mitchell, who was flying over the target area, swung his plane down and sped close around the transport Henderson, followed by another Army de Haviland. The "gallery" of Generals, Senators, Representatives, foreign military attachés and others on board the Henderson waved and shouted their congratulations to General Mitchell as he spun around the transport.

Major General Charles T. Menoher, Chief of Air Service, was among those on the Henderson. He at once sent this radio message to General Mitchell, who caught it in the air:

"Congratulations to you and the entire aircraft brigade on your brilliant performance today."

General Mitchell has flown more than 2,000 miles this week in connection with the Frankfurt and Ostfriesland tests. He wanted to see all the damage done by the bombs and made his own inspection of the decks of both vessels. He piloted the machine, and he had as passenger an Army officer who recorded all observations. On the basis of these studies, as the different phases of the tests proceeded, the instructions to the army bombers in the later operations were formed.

Every bombing machine in all these tests has had to fly a minimum of 200 miles from base to target and return. None of the Army planes was fitted with a pontoon. Accordingly none was able to land at sea.

General Menoher's Opinion

Major General Menoher expressed the following opinion in connection with the sinking of the Ostfriesland:

"A cold material fact has been demonstrated. That fact is that the battleship can be sunk by the aerial bomb. That's the real lesson of this affair. I haven't changed my mind at all as a result of these bombing manoeuvers. I have always contended that the bomb did constitute a very grave menace to the capital ship and that extraordinary precautions had to be taken to meet the menace. That's the whole story. I never

claimed that the menace of the aerial bomb would drive the battleships from the sea. I don't think this shows the battleship is doomed, but I fail to see how any one can now doubt that the aerial bomb does constitute a real menace to the battleship and that it must now be met."

"I should not say that the Army made extraordinary efforts in these tests," General Menoher said in reply to a question. "We have just carried a step further the contentions we have been making. I am exceedingly gratified over the accuracy with which the bombers delivered their bombs at sea 100 miles from the flying field and in hovering over the various targets, all with land planes which could not land at sea. The fact that they have been able to do all this without a single casualty is both important and exceedingly gratifying.

"It shows good training and discipline and demonstrates above all things the ability of the Liberty motor. The Martins as well as the De Havilands which delivered the lighter bombs all used the Liberty motors for these long journeys seaward. It is gratifying to know that we can have as reliable a bomb and fuse as has been used in these tests and turned out by the ordnance branch of the army."

The Need of Aircraft Carriers

Captain W. A. Moffat, Director of Naval Aeronautics, was asked his opinion.

"The lesson," he replied, "is that we must put planes on battleships and get aircraft carriers quickly. I regret that Congress in the new Naval bill failed to provide for airplane carriers. That is now the great need. We must now get them and quickly. We must put aviators on all our battleships to enable them to be ready to ward off air bombing attacks in the event of war, pending the time we get airplane carriers."

Both Army and Navy officers agreed with Captain Moffat that the United services and Congress must now concentrate on getting authorization for aircraft carriers. Captain Moffat thinks eight is the minimum number of aircraft carriers we should have and that they should be specially designed and built to order. The Navy Department recommended only two carriers in its estimates. The House struck out the appropriation, the Senate restored it and then it went out in conference when the Naval bill was passed.

The Army Bombs Used in the Tests

The bombs used by the Army Air Service in the bombing tests of the warships were developed by the Ordnance Department, U. S. Army. The four principal demolition types (300 lb., 600 lb., 1100 lb., and 2000 lb.) used are illustrated herewith, and so is the 1100-lb. armor piercing bomb which could not be used against the Ostfriesland because the vessel sank under the action of the 2000-lb. demolition bombs.

Small fragmentation bombs weighing 17 lb. and 25 lb. were used in the preparatory attacks on the U-117 and the G-102.

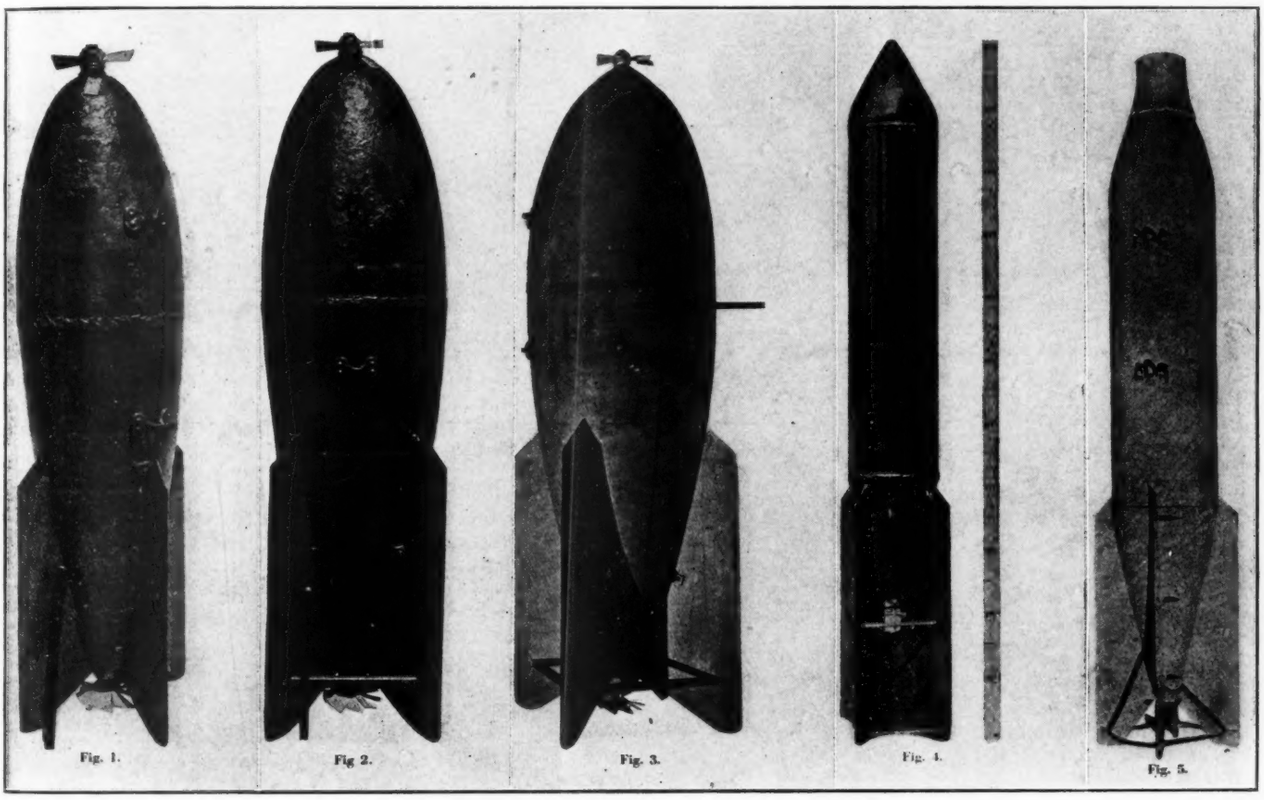


Fig. 1. Fig 2. Fig. 3. Fig. 4. Fig. 5.

AIRCRAFT BOMBS SUPPLIED BY THE ARMY ORDNANCE DEPARTMENT FOR THE BOMBING EXPERIMENTS WITH WARSHIPS OFF THE VIRGINIA CAPES

All these bombs with the exception of the armor piercing type are equipped with both nose and tail fuses, each of which may be arranged to give instantaneous explosion on impact with the target or delay action. During the bombing tests a delay of one-half second was generally used. The fuses are all of the arming vane type, which depends on the rush of air past them in falling to arm the bomb.

Following are the characteristics of the demolition and armor piercing bombs developed by the Ordnance Department for the Army Air Service.

300 LB. DEMOLITION BOMB (FIG. 1)

Approximate Weight	300 lb.
Explosion Charge	50 per cent
Overall Length	4 ft. 1 in.
Maximum Diameter	12.2 in.

This bomb is equipped with nose and tail fuzes capable of instantaneous or delay action.

The nose casing is thickened in order to withstand impact against the ground, substantial buildings or vessels not provided with deck armor.

The rear casing is of thin metal designed to prevent the disruption of the charge before detonation takes place.

There are two suspension lugs on the body of the bomb 14 in. apart by means of which the projectile is carried.

Four flat fins 90 deg. apart gives the bomb stability in flight.

GROUP PICTURE OF THE ARMY AIR SERVICE OFFICERS WHO SANK THE EX-GERMAN WARSHIPS FRANKFURT AND OSTFRIESLAND WITH AIRCRAFT BOMBS

600 LB. DEMOLITION BOMB (FIG. 2)

Approximate Weight	600 lb.
Explosive Charge	50 per cent
Overall Length	5 ft. 1 in.
Maximum Diameter	16.5 in.

This bomb is equipped with nose and tail fuzes capable of instantaneous or delay action.

The thickened casing at the nose permits the penetration and destruction of medium sizes of permanent buildings, light fortifications and naval vessels without deck armor.

The suspension lugs are spaced 14 in. apart on the body of the bomb, one on the nose casing and one on the thinner rear casing.

The four flat fins are braced for rigidity by inter-connecting pin braces. The one foot scale gives an idea of the size of this bomb.

2000 LB. DEMOLITION BOMB (FIG. 4)

Approximate Weight	2000 lb.
Explosive Charge	50 per cent
Overall Length	11 ft. 6 in.
Maximum Diameter	18.5 in.

Nose and tail fuzes assure the function of the bomb with or without delay.

The nose casing is designed to penetrate light deck armor of naval craft, reinforced concrete structures and the bomb is used whenever the maximum of destructive blast is required.

The bomb has no suspension lugs and is carried by a steel sling passed under the cylindrical body at its center of gravity.

The four flat fins are braced in two regions and are firmly joined aft of the clearance hole for the tail fuze arming vane to form a cross.

1100 LB. DEMOLITION BOMB (FIG. 3)

Approximate Weight	1100 lb.
Explosive Charge	50 per cent
Overall Length	5 ft. 11 in.
Maximum Diameter	21 in.

This bomb like the others is equipped with nose and tail fuzes.

The casing is of sufficient strength and the explosive charge is large enough for the attack of major fortifications, concrete buildings, steel structures and naval craft. It is not designed to penetrate armored decks.

This is the largest bomb equipped with suspension lugs, 14 in. apart, for carrying purposes.

The four flat fins are braced for rigidity and to prevent damage in shipment.

1100 LB. ARMOR PIERCING BOMB (FIG. 5)

Approximate Weight	1100 lb.
Explosive Charge	6 per cent
Overall Length	6 ft. 4 in.
Maximum Diameter	12 in.

This bomb is equipped with tail fuze only and in general it is used with delay action.

The casing is throughout very heavy to resist impact with the most resisting targets. A soft metal cap protects the point of the ogive on impact. It is used only when Demolition Bombs have not case strength enough to penetrate.

Two suspension lugs are secured to the bomb 14 in. apart for carrying.

The fin assembly has four flat fins at 90 deg., braced from each other near their trailing edges.

This type of bomb depends principally on fragments for the damage inflicted after explosion, rather than on blast.

Weather Information

Beginning June 10, 1921, a systematic broadcasting of wind and weather forecasts, storm, and hurricane warnings and weather information was begun from the naval radio stations at Portland, Me.; Boston, Mass.; Philadelphia, Pa.; Baltimore, Md.; Norfolk, Va.; Charleston, S. C.; Savannah, Ga.; Jacksonville, Fla.; St Augustine, Fla.; Miami, Fla.; St. Petersburg, Fla.; Pensacola, Fla.; New Orleans, La.; Alpena, Mich.; Buffalo, N. Y.; Cleveland, Ohio; Chicago, Ill.; Duluth, Minn.; Port au Prince, Haiti; San Juan, P. R.; St Thomas, V. I.; and St. Croix, V. I.

This information is out daily on regular schedules indicated for each station. A circular, dated May 28, 1921, has been issued by the Weather Bureau showing the naval radio stations from which the distribution is made, transmitting wave lengths, call letters, information broadcast therefrom, the hours of distribution, and the Weather Bureau stations from which the forecasts and weather information are supplied.

Note.—Copies of the circular may be obtained by application to the Weather Bureau at Washington or to any of its stations on the Atlantic and Gulf coasts and the Great Lakes and from San Juan, P. R.

What General Mitchell Claimed

The following are extracts from the testimony of Brig. Gen. William Mitchell, Assistant Chief of Air Service, before the House Committee on Naval Affairs, given last February. On reading it in the light of the recent bombing experiments with warships it is difficult to realize that his claims should at the time have been characterized as those of a fanatic.—EDITOR.

We have contemplated the use of gas in the attack on warships, but, although we have had no tests of that yet, we think we can do more with explosive bombs. However, everyone on a battleship will have to wear gas masks, and otherwise protect themselves against the fire and gas of explosive bombs. We think we can do more with explosive bombs than any other weapon against the warship, at present. I will tell you why. The characteristic of bombs, as distinguished from other projectiles, is that they carry half of their weight or more in explosives. For instance, an armor-piercing projectile carries only a very small proportion of its weight in explosives. A ton projectile has only about 50 pounds of explosive in it, or 2½ per cent. A ton airplane bomb has from 1,000 to1,400 pounds of high explosives. In this war it was proved that the weight of the explosive, with a high order of detonation of the explosive, is the thing that made the trouble, as distinguished from any projectile which pierced and merely fragmented. Not only did we get effects that we knew nothing about before, in blast, gas effect, and actual heat from fusion, but general destruction from vibration that we never dreamed of before at all. Now, in an attack against an object on the land—against buildings like this—the bombs tear the structure to pieces, both by piercing and exploding. Against things encased in steel, like a warship, very interesting effects are produced.

BRIG. GEN. WILLIAM MITCHELL

We estimate from the studies we have so far made that direct hits on decks and superstructures will break every electric-light globe on the ship, throwing her into absolute darkness below decks; disrupt telephone, radio, and interior communication systems; fill firerooms, engine rooms, and all compartments ventilated by a forced-draft system with noxious gases; cause shell shock to the persons within a radius of 300 feet, disrupt ammunition hoists, dislodge or jam turrets, dish upper decks at least, kill all persons on upper decks (anti-aircraft gun's crews and fire control parties in tops), cause fires to break out, and explode all anti-aircraft ammunition. *Detonation of bombs beneath water line will sink or disable battleships.* If explosion occurs forward of bulge (that part of the ship fitted with longitudinal protection bulkheads), it will cause her to settle by the bow, causing her to decrease speed, to steer badly, and consequently to fall out of formation. If explosion occurs aft of bulge, the after compartments will fill, causing ship to settle by the stern; the main propeller shafts will be thrown out of line, causing almost immediate stopping of engines on that side of ship, consequent slowing down, and inability to keep station in formation. In addition, there is a strong probability that the rudder will become jammed at the same time, making the ship a menace to the ship behind her.

If an explosion occurs abreast of the bulge (or amidships) and does not cause the ship to sink, it will at least cause the ship to take a sharp list, causing difficulties in steering and consequently serious trouble in keeping position in formation. It will also cause a marked change (increase or decrease) in the angle of elevation of the main battery guns, which will greatly decrease accuracy of gunfire.

The explosive bomb is the second class of weapon we have. Its size and weight are dependent on the size of the airplane that is designed to carry it. The biggest airplane now under construction is designed to lift about 5,000 pounds in addition to fuel. Our present service bomber will lift from 1,800 pounds to a ton, with its full gas capacity of five and a half hours.

The third class of weapon we have is the gun. We have so far tried in this country the 30-caliber machine gun, the 45-caliber, the 11-millimeter that we had in Europe, the 50-caliber gun, the 37-millimeter cannon, and the 2.95-in. howitzer.

The point I want to make about aviation is this—that in the development of the air force, it must be remembered that the mission of an air force is primarily to destroy the aviation of an opposing force, and, after you have assured command of the air to a sufficient extent, then to bring a direct attack against the enemy in a way that he will feel it the most. In directing that attack, it may be necessary to hit his centers at a great distance. That is to say, if an enemy were attacking us and wished to destroy us, he most certainly would hit our centers, if he were capable of doing it, in the Middle States, and all the way along our principal lines of communication. Our vulnerable area in this country is in a sort of "T" shape, from Boston to Chesapeake Bay, and from New York to Chicago. If communication in that area were

Commercial Aviation in Germany

By Erik Hildesheim

Commercial aviation in Germany may be considered as being in a condition similar to commercial aviation in the rest of Europe. When an endeavor is made to distinguish between companies in actual operation, and those merely telling what they intend to do consideration usually reverts to the subsidized concerns. So a brief review of German commercial aviation must include a description of the form and aim of government aid to the aircraft industry.

Conditions of Subsidy

Late in the spring the German Traffic Office published a memorandum of negotiations with the aerial transport concerns. As a result of these negotiations the concerns have received, from May 1, 1921, a payment of 10 marks for each of the first 300 km. (200 miles) flown, and 11 marks for each additional kilometer flown. The concerns agreed to maintain services open to the public and to transport 220 lb. of mail free of charge. In event of excess mail the companies agreed either to put into service a second machine, which must then carry 220 lb. free in return for the stipulated subsidy; or to accept payment for the excess at the rate of 10 marks per kilogram of letters and parcels and 2 marks per kilogram of newspapers. The payment for the normal load of mail is by net weight, while that for excess load is by gross weight; the reason for the difference being a standard 10 per cent reduction as, in the normal load, letters have preference to parcels and the latter to newspapers.

The companies received the mail payment monthly, and are responsible to the postal authorities for the safety of the cargo in the same way as these authorities are responsible to the sender. When the mail is carried over two or more lines only the company operating the first one is paid irrespective of whether different companies operate the lines. Exceptions to this are made where connections are made with foreign airlines. In figuring milage the mail authorities work out the distance in a straight line between two cities and then add an allowance of 20 km. Intermediate landings on schedule are payed for at the rate of 10 marks each. Both parties to the agreement are required to give a fortnight's notice in the event of suspension of service. The aerial transport companies cannot be held responsible for delays due to force majeure, and the mail authorities need not notify of suspension during the winter months.

An enterprise is not subsidized until it can prove that is has flown 20,000 km. regularly during the twelve months preceeding its application for subsidy. Payment, however, is made for mail carried during this qualifling distance. Eighty per cent regularity of performance must be maintained to secure payment of subsidy, which is reduced 10 per cent for each 5 per cent failure of regularity. Qualification for the subsidy involves also the operation of at least one machine, built with a direct view to commercial uses,, for every three converted war machines. In this way the German government is creating a market for commercial airplanes. However, even though Germany possesses a well developed system of airlines the number of people actively engaged in aviation is hardly worth the subsidy expended on the lines.

Difficulties Encountered

The Berlin to Augsburg service maintained by the Rumpler Co. shows the effects of the same lack of public interest which was prevelant in the London-Paris services until the rates were reduced. These effects are clearly indicated by the monthly performance sheet of the company, which announces that unless business increases operation of the air lines will be suspended from Nov. 1 to March 31.

Under the ruling of the Inter-Allied Control Commission the Germans have been compelled to surrender the commercial airships Bodensee and Nordstern to France and Italy, respectively and to build, or to pay for the building of, other airships to replace those destroyed. In addition the Germans are prevented from building commercial aircraft until three months after the surrender of the military aircraft yet to be delivered to the Allies. On this basis the German government may announce, when the aerial transport companies apply for further support, that grounds for a subsidy do no longer exist. This would place the aircraft companies in the position of having to seek a customer with ready cash for their products.

The number of companies now producing aircraft is small as the former large concerns such as Aviatik, D. F. W., and L.V.G., have turned to activities other than the production of aircraft. The Hawa, L. F. G. and Albatross companies also have turned to other activities although they still build a few aircraft.

The Hawa Co. has produced a biplane and a triplane adaptation of their tractor machine with the rear cockpit converted into a passenger cabin. This machine is used on the Lloyd air service.

MAP SHOWING GERMAN AIR TRANSPORT SERVICES IN OPERATION (FULL LINES)

The L. F. G. Co. has completed some converted aluminum seaplanes of both the boat and float type at their Stralsund works.

Albatros Co.

The Albatross Co. has under construction a six-seater cantilever cabin monoplane with the pilot's cockpit located over the engine. The machines of this firm have been employed on the Lloyd Ostflug air line in conjunction with Junkers machines. Incidentally the latter firm is the only aircraft company which does not belong to the German Aircraft Association. This firm leads in the production of post-war machines, the type now manufactured being the six seater all metal monoplane of which some fifty have been turned out. Twenty-five of these are as yet unsold. The company is using three, and the remainder have been disposed of by export.

The Sablanig Co. ranks next to the Junkers Co. in the post war production of aircraft, producing a cabin monoplane, and for their former night bombers with the front cockpit converted into a cabin for four passengers. This company uses its own machines on its own air lines.

The Rumpler Co. also employs machines of its own manufacture on its air lines from Leipzig to Nuremburg to Munich between the terminals of Berlin and Augsburg. At Berlin the Johannisthal airdrome has been closed since the revolution in November 1918, and the Rumpler factory which was located there has been transferred to the Bavarian branch of the firm. The machines used on the airlines are the 160 hp. Benz engined school machines with the rear cockpit converted to seat two passengers. The air line to the Swiss frontier also uses this type of machine, but with a 120 hp. Mercedes engine. The Constance-Stuttgart branch of this line uses former Halber-

interrupted by airplane attack, it would be very serious, on account of the industries, the population, the agriculture, and the production, etc., that are in that area.

Of course, you gentlemen are interested in the attack of objects over the water, and the relative value of these various instruments of warfare that modern science calls upon us to develop. Now, the problem of the attack of vessels on the water, I regard in two ways—one, the attack of unarmored ships, and, second, the attack of armored ships. We can attack them in two ways— either by hitting them directly, or exploding missiles in the water near them. Some of us have felt that one was more effective than the other, and others the contrary. I, myself, have thought that we would get much more out of a mining effect than we would out of direct hits. However, we do not yet know.

If it explodes near the stern, it will bend the rudder, it will bend the propeller, and will break the plates to such an extent that the ship will begin to leak badly. With the newer ships, we have not had an opportunity to make a test, but a little bomb just about the size of the bomb in the back part of the room, which contained 214 pounds of T.N.T., was put about 30 feet below the surface, and about 25 feet away from the stern of the Indiana, and, in that case, was sufficient. That was the bomb that bent the shaft, rudder, and made her begin to sink.

The report on that was that it bent the rudder post, broke the plates, and bent the propeller shaft. That ship would have had to get out of line, and she would have been an easy object of attack.

So we have tried to get targets of actual ships to develop our armament and methods of attack, which so far have not received the consideration they deserve, and for that reason we watched the experiments on the Indiana with the greatest interest and care.

Now, we have had a great deal of experience in bombardment from the air over land on the western front, when we had every instrument of anti-aircraft fire brought against us that was known to the civilized world. Not only was every instrument of anti-aircraft brought against us but that was on land where these things could be concealed, where they could be massed in the greatest numbers, and not on the sea, where you have an absolutely unobstructed vision. We know a great deal about anti-aircraft, both against us and what we used against the enemy, so we can tell you pretty well from the experience we have had in the war what it is worth and how it will have to be handled from the ship in order to have the greatest effect against us. We know that pretty definitely. We know that under the conditions that obtained not only will we have very little loss from it but we can injure it by our attack aviation at the low altitude of from 100 to 300 feet. We will come down and attack them. Next, we know, according to size of the target, how many projectiles and at what height and with how many planes we have to attack in order to succeed. I think that the present Navy torpedo is a very inefficient weapon to use from airplanes for the reason that for the total weight, you carry only 20 per cent of explosive. You have to come down to within 20 feet of the water to launch it, where you will be exposed to the pursuit ships and exposed to every attack possible from anti-aircraft armament on the same plane. You are confined practically to the surface of the water for the purpose of launching this torpedo. We believe furthermore that the same weight carried in explosive bombs, which hit within 60 feet of any ship, will cause very much more damage. The advantage of a torpedo is in putting it in actual contact, below the water line, with the object that you desire to attack. The difficulty of using the water torpedo, its slow speed and its relative small charge of exposive, are limiting factors. We believe we will get more out of explosive bombs, but that is a matter that must be tried and proved, and we want to do it just as soon as we can. Our opinion of a water torpedo is not high. An air torpedo is a different proposition, one that is impelled in a horizontal direction through the air. We know we can carry great weights with it, and we can precipitate it on a ship at high velocity anywhere above the water and probably under the water for attacking under the bottom. That is a matter of development. We must develop weapons for use from the air as distinguished from use on the water or on the ground; there is very little similarity between the two, and if you do not coordinate all of these air matters under a single direction for a specific object, you are not going to get proper developments, because Tom, Dick, and Harry are using them. The trouble is that we do not like to see things destroyed that we have been brought up to revere and protect; that is human nature and it is nobody's fault. The battleship is looked on all over the world by all the navies as being the thing that must be glorified. We think we can destroy it; it is our business to attack it, and it is up to you to judge whether we can do it or not.

The following are the reasons why naval seacraft should be turned over to the Army Air Service for use as targets: The Army is charged with the defense of the coast. In the event of war, the Army Air Service would be called on to attack hostile navies or shipping without the cooperation of the Navy, because if a hostile Navy approached our shores our own fleet would have been destroyed or neutralized. Under the present law, the Naval Air Service acts with a fleet, the Army Air Service handles all air operations from shore. In the development of missiles for aircraft, no actual experience in air attack against seacraft has ever been had. A Navy is composed of both unarmored and armored vessels, and among all the means of air attack we must determine which are the best we have now and what line of development we must follow. For instance, there is no use wasting a large projectile against a destroyer, supply ship, or other unarmored vesse'ls. It may be better to hit in the water near it than directly. Cannon and machine-gun fire delivered in certain ways may be better, as might gas, incendiary bombs (against tank ships), torpedoes, or other projectiles. Our tactical methods must be coordinated to carry on the proper operations to get effect which can only be done against targets of this kind. The Army has personnel which is experienced in bombing, due to their service in the late war, and also has airplanes expressly designed for the purpose of bombing. These airplanes are capable of carrying greater amounts of explosives than are the Navy airplanes, which, due to the fact that they are equipped with pontoons or boats so that they can land on the water, are much heavier than the corresponding types of Army planes with their light landing gears designed for ground work only. The obsolete battleship Massachusetts was recently turned over to the Coast Artillery of the Army for use as a target, and the Navy has already experimented on the obsolete battleship Indiana. The Army Air Service is only asking that it also be allowed to experiment on obsolete seacraft with a view to perfecting its armament, finding out which weapons are suitable for the various conditions of attack, and developing its tactics for this purpose. Without such a test according to Army Air Service methods, no real test of aircraft can be arrived at. No such indication would exist, for instance, if in a joint maneuver now with no experience whatsoever the Army Air Service (under conditions which the Navy would prescribe as to bombing), should be sent 100 miles or more to sea to bomb a target in cooperation with the Navy. This would give the Army Air Service no indications as to its effectiveness. As a matter of fact, a fleet remains in harbor at anchor for the greater part of the time, and an air attack under such conditions is as important as any other.

In addition to bombing the seacraft, the Army Air Service desires to ascertain by placing animals on various parts of the ships, the probable effect of gas on the personnel of this ship. It also desires to obtain data as to the effectiveness of blinding the personnel of the ship at night, or even in the daytime, by the use of powerful parachute flares. This is important, for if effective, the personnel of the ship would be unable to see the airplanes, while the ship will stand out plainly as a target, due to the illuminating effect of the flares. This would mean that the aircraft would have an easy target while the personnel aboard the ship would be unable to locate anything in the air at all, which would permit aircraft, both lighter and heavier than air, to fly at extremely low altitudes while dropping their missiles.

The Army is specifically charged with carrying out attacks against shipping from shore airdromes. Cannon have been used in war and peace for 500 years. Give the air a chance to develop and demonstrate what it can do.

Commercial Aeronautics and War

By James Valentine, Jr.

Ex-Lieutenant, R. A. F.

When the public is finally convinced of the tremendous loss it is suffering by the absence of commercial aeronautics, and by support of it makes it practical there will arise the aircraft industry of the future which will build our future commercial aircraft.

Since it seems likely that the late war was by no means the last war, and since the aerial arm of both services dominates their attack and defense; speculation as to the war time functions in assisting our unified air service which will by then have been created—of the commercial aircraft industry will be interesting and instructive.

Consideration of the probable organization of the aircraft industry is first in order.

Present indications point to the absence of aerial transport lines operated by companies constructing aircraft. This is another illustration of the parallels which exist between things nautical and aeronautical in that not one of the large steamship lines builds its vessels.

Thus commercial aviation, as commercial water transportation, will have two ends—the operation end, and the construction end; the latter building aircraft to the specifications of the former. The organization of these two ends of the business will be along the lines of the following outline—

1—Construction
  1. Personnel
    A—Air
    é—Ground
  2. Matériel

II—Operation
  I. Personnel
    A—Air
    é—Ground
  II. Matériel

The personnel of the construction end will be divided into air personnel and ground personnel. The former will include the pilots, engineers, radio operators, and navigators together with their several staffs and assistants who will test new types of machines with their accessories and auxiliaries; or finished machines before they are delivered to customers. The latter will include factory managers, designers, heads of departments, and all their staffs and assistants.

The matériel of the construction end will consist of aircraft factories with their vast number of accessories and auxiliaries such as testing and experimental stations, work shops, designing rooms, and sales offices.

The personnel of the operation end, as that of the construction end, will be divided into air and ground personnel. The former will include pilots; navigators; engineers; and radio operators—all with their staffs and assistants—and the various people who will attend to the handling of passengers and merchandise. The latter will include engineers, riggers, traffic managers, airport managers, and radio operators—all with staffs and assistants to carry on both maintenance and repair work.

The matériel of the operation end will consist of airways, air ports, aircraft, and the accessories and auxiliaries necessary for their maintenance and repair such as radio and navigation equipment, motor transport, and repair shops.

Such will be the probable organization of that future big industry—commercial aeronautics. Consideration of the part to be taken by this industry in war, and its subsequent development as the war progresses is next in order.

As far as the public is concerned war happens suddenly. Those in a position to know, however, are aware sometime in advance that war is going to be declared and preparations are, or should be, made accordingly. Thus, prior to her entrance into the last war, Great Britain mobilized her fleet for a so-called naval pageant, while we, before our entrance into the same conflict, mobilized various units for a socalled punitive expedition into Mexico.

So that before the next war is actually declared the "powers that be" will be well aware of its coming and accordingly will, or should, mobolize the resources of the commercial industry, and thus put into mass production the types of war aircraft which have been adopted.

In connection with this the question arises whether the aircraft industry in its production of war aircraft will remain under the control of private interests and produce to meet government inspection; or whether the industry as a whole will be commandeered by the government.

The latter seems probable in view of the general policies of the government and the injustice of industrial exemptions during the last war. Whether such a policy will be conducive to efficiency calls for a nicety of judgment and remains to be seen. Certainly government control in the past does not indicate much in its favor in that it eliminates competition and stifles incentive. This, however, will be counteracted by the enthusiasm which will be prevalent for the successful prosecution of the war.

In the event of war the personnel of the construction end will be used wholly in the production of war aircraft with the exception of the adventurous few who will run away to do as they please and thus add their names to the list of those who have kept this from being a dull world.

Of all the departments of commercial aeronautics the matériel of the construction end is the most vital and important as far as active participation in war is concerned. Immediately war is declared the burden of the aircraft program will fall on this division, and it will have to mobilize all its resources to bear it. If present indications as to the nature of the next war are true then the fate of the nation will depend on the controvertibility of our commercial aircraft factories to factories for the production of war aircraft.

The tendency of the modern industrial system is to standardize. The argument in favor of this being that it increases production, which is true; but when the aircraft industry is called on to produce war machines it must guard against too much standardization. Sufficient flexibility of organization must be maintained to keep pace with the constant changes which will be taking place as the war progresses.

As an illustration of this let us look at the relative positions of the German Air Service, and the British Royal Air Force during the last war—notably in the realm of engine manufacture. The Germans had developed standardization to a high degree, and thus were enabled to put into production vast quantities of certain types of engines. The British too had developed standardization but not to a degree that did not permit of flexibility. The result was that while the Germans had greater numbers of a fewer types of engines the British had fewer numbers of more types the best of which, when placed on the front where they were most needed, enabled the Royal Air Force to gain the ascendency.

On the other hand, early in the war the British had tried rigid standardization at the Royal Aircraft Factory at Farnborough with the notorious R. A. F. 90 h. p. and 140 h. p. air cooled engines, and found it to be a bad policy so they changed.

Standardization is necessary but there is a limit; and that limit is reached when advances cannot be quickly taken advantage of. That is what must be guarded against by our commercial aircraft industry in its production of war aircraft.

In the event of war the personnel of the operation end will be divided, part going into the service and part helping to carry on the war aircraft program. In the service the air personnel will be valuable in testing and ferrying capacities; and probably, after a course of training to replace their commercial flying with war flying, they will make good combative personnel. The ground personnel will readily adapt themselves to the roles of quartermasters, testers, and the various duties the proper fulfillment of which will keep a dominating number of service machines in the air.

stadt two-seaters. However, the tendency to use cheap converted war aircraft on commercial lines is not so great in Germany as in other countries because of the ban put on such machines by the Allies and the resulting seizures.

Carl Caspar has given up the large factory of the Hanseatic Airplane Works in Hamburg and has purchased the Fokker branch works at Lübeck- Trawemunde, which belonged at one time to the D. F. W. Co. He has resumed the construction of Friedrickshafen type seaplanes for Norway. The Hanseatic works which he has given up are now engaged in furniture manufacture.

Dornier has the greatest number of post war types to his credit. They are all of metal and each one embodies new features. The land and boat seaplane monoplanes have been demonstrated in Holland and Switzerland, and in the latter country, on Lake Constance, a short airline is planned. Dirnier developments are principally along experimental lines, the specimen machines being manufactured at the Seemoos plant.

The Air Transport Services

The German air transport services in regular operation are shown on the accompanying map. For the most part they may be divided into large groups; first, the Deutsche Luftreederei, by far the greatest aerial transport concern, formed by the well known A. E. G. concern with the Hamburg America Line as agents; and second, the Lloyd Luft-Dienst, which unites most of the other companies. The Norddeutscher Lloyd is the chief backer of this group. Both these leading German shipping companies are taking an active interest in commercial aviation, the explanation being that the war has left them with out their marine fleets, and also that the Hamburg America Line was the agent for the German Airship Transport Co. (Delag)—now defunct, for the time being at least.

The Deutsche Luftreederei operates four lines, viz. Berlin to Dresden, Berlin to Dortmund, Danzig to Memel, and Hamburg to Bremen which connects with the Amsterdam to London service. The Danzig to Memel route connects with the Lloyd Ostflug line to Königsberg. The Lloyd Air Line Sablatnig connects at Bremen with the line to London operated by the Royal Dutch Navigation Co. (known by its Dutch initials as K. L. M.) Connections are made by this line as German airplanes are prohibited from leaving the country. From Bremen the Lloyd Sablatnig line continues to Dortmund, and a service from the former city to the north sea resort of Wangerooge has been inaugurated.

The Lloyd Air Service announces the opening of the Baltic Coastal Air Line: Travemünde to Warnemünde, to Sassnitz, to Swinemünde. The last named city is within easy reach of Settin and thus in direct air communication with the German capital. The Bavarian Lloyd air line and the Paul Strehle air line are operating in the south of Germany. The newest air line to commence operations is the German Air Lloyd with its line from Hamburg to Magdeburg where connections are made for Berlin. In the future machines will go from Leipsig to Dresden, omitting Breslau as a terminal.

Among the companies of the Lloyd organization yet to be mentioned are the Badische Luftfahrt A. G., which has discontinued flying for the present; and the foreign concerns: the Danish Air Express, the Vienna Air Traffic Co. and the Danzig Air Mail Co. The first of these has been financed and provided with airplanes by the Sablatnig Co. and so has failed to get registered for operations in Denmark. The Austrian company was to have co-operated with the Rumpler Co. but the first three airplanes despatched from Munich to Vienna were seized by the Inter-Allied Control Commission and there resulted the order prohibiting German aircraft from flying abroad. The Danzig Air Mail Co. works in conjunction with the Danzig to Memel Service of the Deutsche Luftreederei.

Passenger Rates

The passenger rates are given below, those in brackets being for a round trip.

1. Berlin-Braunschweig: 300 Mark (500 M)-Dortmund: 500 M (800 M). Berlin-Dresden: 300 M (500 M). Danzig-Königsberg: 240 M-Memel: 400 M. Hamburg-Bremen: 275 M (400 M) Amsterdam: 75 Florins (130 Fl)-Rotterdam: 100 Fl (180 Fl) Bremen-Amsterdam: 50 Fl (75 Fl).

2. Berlin-Bremen: 450 M-Munster 650 M.

3. Berlin-Liepzig: 450 M-Nuremberg: 1125 M.-Munich:-Augsburg: 1725 M.

4. Berlin-Stettin: 225 M.-Danzig: 900 M.-Königsberg: 975 M. Danzig-Königsberg; 250 M.

5. Munich-Konstanz: 400 M (650 M).

6. Berlin-Magdeburg: 225 M. Hamburg-Magdeburg: 300 M-Breslau: 700 M.

7. Stuttgart-Konstanz: 450 M (700 M).

The ticket price of the Deutsche Luft-Reederei includes automobile transport to and from the Johannisthal airdrome at Berlin; the Rumpler Co. includes passenger insurance. The mail rates are given in the following table:

		Letters	Prints	Samples	Business Papers and Mixtures
Up to	20 g	—.80 M	—.95 M	1.40 M	1.40 M
" "	50 "	1.60 "	—.95 "	1.40 "	1.40 "
" "	100 "	2.40 "	1.90 "	2.20 "	2.20 "
" "	250 "	3.60 "	3.— "	3.— "	3.— "
" "	500 "	— "	5.60 "	5.60 "	5.60 "
" "	1000 "	— "	10.60 "	— "	10.60 "

Post cards 0.60 Mark. Parcels below 1 kg. weight 11.10 M maximum dimensions: 60 cm. length. Urgent delivery of heavier parcels 10 mark per kilogram and fraction thereof. Newspapers at special rates in inland to Denmark and Sweden. Foreign 0.40 mark for postcards, 0.40 mark per 20 g of letters and 1 mark per 50 g. prints. Registry 1 mark.

The following tabulation, obtained from the Rumpler Air Line in May 1921, shows the working of the German inland flying services:

	Berlin-Leipzig Leipzig-Berlin		Augsburg-Munich Nuremberg-Leipzig	Leipzig-Nuremberg Munich-Augsburg
No. of flights scheduled	32	31	31	31
No. of flights not carried out	1*	1*		2*
No. of interrupted flights	1*	1*		4*
Average fl'ts duration, hours	1,05	1,10	4,05	4
No. of passengers carried	7	3	41	42
Amount of mail carried lb.	116	30	25	215
Percentage of reliability	93.5	96.6	96.6	81

* Defaulted on account of bad weather.

Civil Aviation Abroad

Australia

Pilot F. L. Roberts, in an Avro airplane belonging to the Australian Aircraft and Engineering Co., had a remarkable experience in the air. He left Armidale, N. S. W. with two passengers, and was at an altitude of about 3,000 ft. when a storm approached. He shut off the engine and after gliding for three minutes noticed that instead of descending they had actually gained 100 ft. in altitude. They were evidently in a strong upward current. These currents are noticeable over the western country of eastern Australia and it is certain that in the future the study of the flow of atmosphere will lead to developments with aircraft.

A Curtiss Seagull flying boat, the property of Aerial Company Ltd., has left Sydney to commence an extensive aerial survey of the eastern coast of Australia. The Aerial Co. Ltd. is conducting the survey in order to blaze the trail for commercial aviation on the coast of Australia and adjoining territory. The company will hand over to the Controller of Aviation, the data and photographs collected as the result of the survey.

France

Some instructive experiments are now being made in France in the cooperation of airways with railways. One test, involving a regular inter-working between the Nimes-Nice airway and the night express on the P.L.M. railway between Paris and Marseilles, is being watched with particular interest.

French Guiana

The three Guianas will soon be linked together by air transport. Planes now operating between towns on the coast and interior carry gold, balata, essence of rose, etc., covering vast distances. For example, planes fiy between Saint-Laurent to Cayenne in 6 hours, whereas by canoe it would require 20 days.

The service will readily find use for the airways and airports of the operation end. Certain of their accessories, notably the motor transport and work shops will also be requisitioned. The aircraft will be useful in supplementing what are now considered orthodox means of transportaion; but as far as combative service is concerned they will be useless. And this is just the point about which so many people who should know better are deluded. Replacing knowledge and reasoning with erratic imagining they visualize all manner of commercial aircraft, bereft of their proper appliances, hurling destruction on the enemy. Rather should they visualize the converted aircraft lumbering along to their destruction at the hands, or rather the guns, of fast pursuit machines from the carrier ships of the enemy fleet; which pursuit machines will have by this time penetrated the defenses of the commercial machines' escort because of the latter being handicapped by the antics of the former.

All of which is meant to prove that the success of our aircraft operations in war, and hence the safety of the country, will depend not on the convertibility for war purposes of commercial aircraft; but rather on the convertibility for war purposes of the industry which produces these aircraft. Furthermore, advances in aircraft design take place so rapidly that to put into production any particular types in times of peace is wasteful on account of the scrapping which must be done in the process of replacement.

Waste is relative. Procedures carried out in war would never be tolerated under peace conditions. The fact that they contribute to the successful prosecution of the war is their justification. The complaints about waste materialize when the danger of war has been removed. Hence it will be well to leave all scrapping of aircraft and replacements to war time, when they will surely be necessary; and so adjust the peace time program as to provide only sufficient of the advanced types of aircraft as will meet the requirements of experimentation and training.

It follows then that our aircraft policy should be such as to provide for extensive research work, and the consequent maintenance of a few of the advanced types of aircraft for testing and training purposes together with a skeleton organization under which these aircraft may at once be put into mass production by the commercial aircraft factories.

Under such a system there will be flexibility permitting of easy change with a minimum of waste, and preparedness supported by the resources of a vast industry.

The Lakehurst Naval Airship Station

The U. S. Navy Airship Hangar at Lakehurst, N. J. is the terminal for the airships which will be in use in this country within the next few months. It is 803 ft. long, 264 ft. wide and 190 ft. high. The doors at each end are 170 ft. high and are 264 ft. wide. Observation platforms on the roof command a view of the Atlantic seven miles distant. In another direction equally as far away Lakewood can be seen clearly; while in the vicinity the 1400 acre reservation is being cleared to provide workshops, shelter and transport facilities for the 800 enlisted men and 500 civilian employees who will man the hangar and care for the two airships.

The airships are the ZR-1 and ZR-2, the former being built at League Island Navy Yard, Phil., and the ZR-2 now undergoing trials in England. The hangar will be completed before the scheduled trans-Atlantic flight of the ZR-2 in August. The airships are each 700 ft. long and 85 ft. in diameter. Capt. W. A. Moffett, Chief of Naval Aviation, is of the opinion that commercial aviation will receive considerable impetus from the operation of the Navy dirigibles and their terminal. Accordingly, all preparations at the Lakehurst hangar are with a view toward establishing facilities and conducting experiments which will aid commercial transport, and at the same time, keep the public informed concerning the progress in the development of lighter than aircraft.

In addition to the great hangar, the Navy plans to erect a mooring mast to which the big airships may be moored. The mast will be so constructed that the giant ships will be moored bow on to the mast, and will swing in the direction of the wind. The Navy contemplates also the erection of other mooring masts throughout the country. These will be based on results of experiments with the Lakehurst mast.

Work was first started on the station in September, 1919. When Commander H. M. Eddy of the Bureau of Yards and Docks arrived at Lakehurst with his force of 800 men, he found a wilderness. They had to clear hundreds of acres and lay a branch railway to the main line before commencing work on the hangar. The tractor tanks used by the Marine Corps during the war were employed to pull stumps. Today the hangar is nearly completed and Captain Moffett has assigned Comm. R. D. Weyerbacher of the Bureau of Construction and Repair, and lighter than air expert for the Navy, to supervise preparations for receiving the ZR-2.

The doors of the hangar constitute the chief engineering problem. Each leaf is made up of 800 tons of steel and corrugated asbestos. There are two leaves on each end, opened by rolling parallel with the front of the shed. They are supported on concrete trucks which in turn rest on wheels, the size of those on a freight car. Similar trucks, set out from the doors and parallel to them, support huge steel girders braced against the top steel framework on the doors, and act as braces against winds which sweep through the shed. Like the doors, the entire siding of the shed is corrugated asbestos, arranged in strips alternating between gray and two shades of brown, so camouflaging the shed as to break up its outines and make it difficult for a hostile observer to locate it from the air.

In addition to a railroad running lengthwise through the hangar there are three trolley slots which are known as docking rails. The dirigible about to enter the hangar will be fastened by cable to these rails which extend on a 1500 ft. runway at either end. Anchored to the rails it will be a simple matter to guide the airship into its berth.

Up under the roof among the steel rafters, five monorail cranes support movable platforms which enable the workmen to repair the airship after it is housed. Suporting these rafters are nine trusses forming arches, arranged in pairs.

The roofs act as a resevoir, catching rain water which is stored in three tanks and used in the engine radiators. The windows in the sides and roof require individual motors to open them. The glass is amber-colored, to eliminate certain light rays, destructive to balloon fabrics.

The hangar is as fire-roof as possible. The concrete floor is covered with asphalt to prevent falling tools striking sparks and exploding the gas, and incidentially,to to maintain warmth. The heating is entirely beneath the floor, distributed through three tunnels. All wiring where possible is on the outside of the shed. The power plant is located some distance away, as is the gas plant which will have a daily capacity for manufacturing 75,000 cu. ft. of hydrogen, later to be increased to a hundred thousand cu. ft. capacity.

Search lights on two diagonal corners of the hangar will guide the dirgibles at night. On the other two corners are flood lights which will illuminate the field to the extent of 20 acres. Sunken lights arranged like crosses have been installed at the end of each runway, also to facilitate landings at night.

A twenty-five h. p. electric motor is used to open each leaf of the doors. It performs the work of men who would otherwise be employed at great loss of time. Navy men calculate that it will require just thirteen minutes to open the doors to receive a dirgible and approximately forty minutes for landing and housing it.

This terminal was built at a cost of between four and five million dollars, Capt. Frank T. Evans, son of "Fighting Bob" will be in command of the station.

Fiat 10 Passenger Airplane

The Fiat Co. has recently produced a 10-passenger airplane which embodies the results of long and minute studies of all details and devices, so as to ensure an almost perfect safety and a regularity of running incomparably superior to what has been obtained up to date. It is a big biplane with completely rigid body and central fuselage carrying the engine apparatus, the controlling cabin, the passenger cabin, the toilet closet, and all other installations required by modern comfort for a long journey. The airplane is shown on the annexed drawing.

The design of the airplane embodies the following features:

a. Three engine power plant apparatus driving one tractor propeller.

b. Good visibility for the pilot and ease of access to the power plant for the mechanic.

c. Comfortable passenger cabin with good visibility.

d. Fuselage of trellis-work covered with ply-wood ensuring a high factor of safety.

e. Maximum speed over 125 m.p.h. minimum speed under 50 m.h.p.

f. Four-wheeled landing gear.

g. Balanced control surfaces and adjustable tail plane.

h.HighL/D ratio.

The Power Plant

The three engine power plant was adopted to avoid the dangers of engine failure in a single engine. The distribution of the power in units on the wings has been avoided. This system as practiced gives a higher propeller efficiency, but is the source of trouble due to the length of complicated pipings not always protected and easy to inspect, impossibility of inspection of the engines during flight, and small effect of the the slipstream on the tail plane. Besides these troubles another drawback to the multiple engine system driving multiple propellers is the fact that any lack of traction of a single propeller other than the central one causes a dangerous turning moment.

The three engine power plant aims to eliminate the disadvantages and retain the advantages of the division of the power plant into units. The three engines, by means of clutches, are automatically disengaged from, or engaged with, the propeller shaft. In this manner an engine giving trouble can receive attention during flight at the expense of reduced speed on the part of the whole machine.

Fuel and oil for 8 hr. are carried.

The stoppage of any one of the three engines results only in a decrease in the speed of the airplane which however cannot drop under 110 m.h.p., a decrease of only 14% of the maximum speed. In this manner a reserve of power is created to be called on when necessary.

Structure of Wings and Fuselage

The wings are of the usual rigid spar type with lift balanced ailerons. The lower wing has 2 deg. dihedral and the upper wing an extension. The gap is 85 percent of the cord.

The fuselage is of trellis work covered with ply-wood which combines qualities of lightness, strength and minimum head resistance. All fittings are designed with a view to simplicity, strength and streamlining. As a result of the designing and workmanship a factor of safety of 8 has been attained.

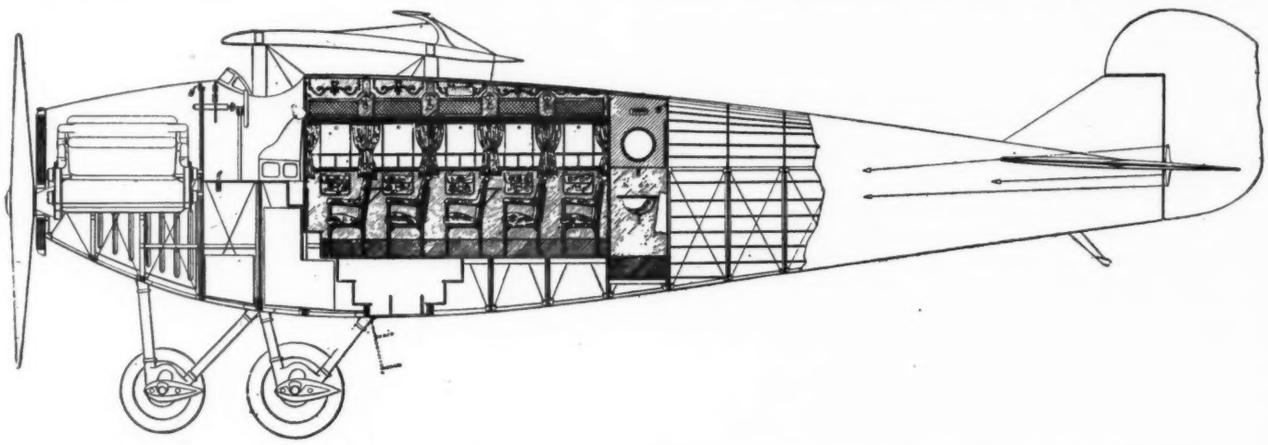
Controls

Dual controls with an adjustable tail plane are provided. Simplicity of design in the control system has been aimed at.

Cockpit and Cabin

These have both been designed to give good visibility. The cockpit is located between the engine and the main planes, and connects with the cabin by means of a trap door. In the front of the cockpit is another trap door which gives access to the engines.

The cabin is roomy and comfortable, with five seats arranged down each side of a center aisle and with a toilet room aft.



Cross-Sectional Diagram of the Fiat 10-Passenger Airplane, Showing the Arrangement of the Fuselage

Performance

The maximum speed of the machine is 125 m.h.p. and the ceiling 15,000 ft. The landing speed was not stated in the performance statistics.

Cadet Classes for Lighter-Than-Air Service

The regular course for cadets in lighter-than-air service in the Army Air Service will begin about Oct. 1. The cadets are to report on Sept. 25, and the course will end about Feb. 10, 1922, depending upon meteorological conditions. Those who successfully complete the course will be commissioned second lieutenants in the Air Service Officers' Reserve Corps, which grants them eligibility to take examinations for commissions in the Regular Army.

Proposed Air Mail Service

An act providing for the carrying of mail by airplane between Nassau, Bahamas and Miami, Fla. has passed its first reading in the Bahama House of Assembly. Certain concessions are granted to the Bermuda & West Atlantic Aviation Co., a British limited company with registered offices in London, and a subsidy of $25.000 a year is provided.

The Psychology of Passenger Carrying

Interesting views on the psychology of passenger carrying are expressed by Robert Gordon, who has for some time been associated with Edward Stinson in commercial aviation.

In the three years of his passenger carrying business Mr. Gordon has given 8,000 people flights without an accident. Speculation, then is interesting as to how many of these people would fly again when given the opportunity. In other words—having covered certain territory for passenger carrying, and had it pay, what are the chances of profit on returning to this territory? This involves an interesting study of crowd psychology, and in this conection Mr. Gordon says, "Anyone who has done any passenger carrying knows that the passenger just landed is the best advertisement to be had, for he, or she is enthusiastic and persuades friends to fiy. This is true also for a return tour of the passenger carried as I have proved to my satisfaction.

"Last fall, before flying to Mount Kisco, N. Y., I communicated with the editor of the newspaper in that town, and as a result he was kind enough to feature my coming. I arrived in a Canuck, carried passengers for a day, and left in the evening to keep an engagement the next day at Liberty, N. Y. Last May Mr. Stinson and I were at Mitchell Field and to prove my theory we flew to Mount Kisco again and landed unannounced, this time in an Avro. We carried as many passengers as on the previous trip, and this minus newspaper publicity, and in face of news of a crash that created nationwide attention and which was the chief topic of conversation on the airdrome. Upon comparing my books of this trip with those of the previous one, I found that fully two thirds of the passengers were repeaters.

"As far as possible, I am keeping a record of all the places in the country that have been worked and, though this record is necessarily incomplete, I firmly believe that of the towns of at least 5000 inhabitants not more than 10 per cent of them have been visited by passenger carrying airplanes. Applying this ratio to the states, I find that in New York State alone there are approximately 35 towns of 5000 inhabitants which have not been worked. Furthermore, my records show that in towns of 5000 inhabitants one in every hundred will patronize a passenger carrying machine, while in cities of 20,000 the ratio is one in every two hundred.

"A feature conclusively proved is that on the second trip to any place a type of machine different from that used the first time will bring better results. This was illustrated in my trips to Mount Kisco—the very fact that the Avro differed from the Canuck, particularly in the feature of a rotary engine, made people anxious to ride. I asked many passengers why they were repeating the ride, and the answer invariably was to the effect that this was a new machine and hence they were anxious to try it. If that is so in Mount Kisco it is so elsewhere.

"I was recenty asked by the editor of a prominent aviation paper what the possibilities of the monoplane were in passenger carrying work. He knew that Mr. Stinson and myself had been experimenting with the new Sperry wing for attachment to Canucks. My reply to him was that the monoplane promises to do well as a passenger carrier. It has stability, maneuverability, visibility, and good load carrying capacity. Furthermore the absence of the lower wing is an advantage in "barnstorming" in that it increases the life of the machine because crowds cannot damage it by contact when the machine is on the ground. Another advantage of the monoplane is that its design is new to crowds and consequently attracts them. New types of machines and advance publicity are the keys to success in the passenger carrying work, and I am now planning another trip on this basis."

Civil Aviation in the British Dominions

A report on the progress of civil aviation during the period from Oct. 1, 1920, to March 31, 1921, recently issued by the British Air Ministry contains interesting information about the organization of civil aviation in various parts of the empire.

Information with respect to Canada is here omitted on account of its previous publication in AVIATION AND AIRCRAFT JOURNAL.

Australia.—The Air Navigation Bill was assented to on Dec. 2, 1920, and an Air Board has been established consisting of a Director of Intelligence and Organization, a Director of Personnel and Training, a Director of Equipment and a Finance Member. The Air Board is responsible to, and subject to the control of, an Air Council which comprises, under the presidency of the Minister of Defense, a naval member, a military member, two members of the Air Board, one nominated by the naval and one by the military member, and the Controller of Civil Aviation, who is directly responsible to the Minister of Defense. The principal function of the Air Council is to advise the Minister upon the general control of the Commonwealth's air policy in its naval and military aspects, and to coordinate civil aviation therewith.

Air Navigation Regulations were issued on Feb. 11, 1921, and three superintendents—*viz.*, of air craft, airdromes and flying operations, have been appointed to administer them.

The Cabinet has approved the operation of a Government air mail service by the Royal Australian Air Force, and the relative merits of two routes, Toowoomba-Winton and Geraldton-Derby, are being discussed.

Schemes are also under consideration for the establishment by private companies of regular air services between Sydney and Port Augusta (South Australia) and between Winton and Longreach (Queensland).

India.—The Air Board, which works under the Commerce Department of the Government of India and deals with questions of civil aviation arising in India, is a purely advisory body without executive functions. Owing to financial conditions in India it has not been found possible as yet to develop any trunk routes, but as soon as funds are available the Government of India has decided to prepare a main trunk route from Rangoon to Bombay, via Calcutta and Allahabad, attention being concentrated in the first instance on the preparation of the section between Calcutta and Rangoon. As soon as the route is completed, or a section of it, it is intended to call for tenders for an air mail service over the completed portion. The Government of India have also empowered local governments to lay out air routes within the boundaries of their own jurisdiction with the idea that subsidiary air routes will by this means be eventually established connecting with the Rangoon-Bombay trunk route.

The import duty on aircraft, aircraft engines and accessories has been reduced from 7½ per cent to 2½ per cent ad vaorem (not from 17½ per cent as stated in the last report).

New Zealand.—Air Regulations were published on March 18, under the Aviation Act of 1918. They are provisional pending the introduction of a new Act enabling effect to be given to the International Air Convention.

Contracts have been approved by the Cabinet for air mail services between Auckland and Whangarei, and between Christchurch and Timaru. Provision will be made for the carriage of passengers in addition to mails.

South Africa.—Pending legislation which is now being drafted, an Air Board has been appointed to advise the Government on air legislation and regulations, the development of aeronautics, proposals for the establishment of air mail and passenger services within the Union and between the Union and adjoining territories, and on all matters of general policy affecting civil aviation.

A New Aircraft Firm

The Cox-Kemlin Aircraft Corp. Inc., Consulting, Designing and Constructing Engineers, has recently been incorporated under the laws of the State of New York. The capital has been privately subscribed, the financial position of the company is sound, and the plant and the facilities are large enough to meet the present needs of the industry.

L. Charles Cox, President and General Manager has been interested in aircraft work for the last six years, having served three and one-half years in the Royal Flying Corps and the Royal Air Force. He was connected with the Lawson Aircraft Co. as Assistant to the President and as Chief Pilot. Later, he organized the Airliner Engineering Corp., which company constructed the twin-engined thirty passenger airliner which recently has made several flights at Hazelhurst Field. Mr. Cox was General Manager during the construction of this plane, which was built within five months, somewhaf of a record for a machine of this size.

The Vice President and Chief Engineer is Alexander Klemin. The engineering organization of AlexanderKlemin & Associates has been taken over by the new company and has been transferred to the factory together with its library, engineering records, and files.

The Shop Superintendent is F. W. Vista, who has been for many years associated with the L. W. F. Engineering Co. as Assistant Shop Superintendent, and has had a large and varied experience in the construction of all types of aircraft.

The company has taken over a plant of the College Point Boat Corp., which during the war built H. S.-2 boats. This plant is fully equipped for the construction of aircraft on a small scale with excellent assembly, metal, wood and other shop facilities. The plant is situated at College Point, which is readily accessible to New York, and is right on Flushing Bay. The company has started construction on a number of passenger boats on private order, is bidding on government contracts, and is also offering its facilities for rebuilding and repairing of airplanes of every type and variety. The company is also offering the services of its engineering staff to transportation companies in planning air lines and in selecting suitable types of machines for their services. Assistance will also be given to inventors in engineering and constructional development.

A 4000-lb. Aircraft Bomb

The Ordinance Department of the Army is making plans for an aerial bomb to weigh 4,000 lb. which is very much larger than any bomb of the kind ever before conceived in the United States. It is to contain over fifty per cent. or 2,400 lb. of TNT, and will be one of the most deadly of all bombs known in modern warfare. Up to the present the largest bombs designed and constructed weigh but 2,000 lb. These already have been adopted as standard, together with bombs weighing 1,100 lb. 600 lb. 300 lb. and 100 lb. respectively, all of which contain about fifty per cent. of TNT. The new bombs weighing 4,000 lb. are to be used in connection with the largest bombing airplanes.

Navy Air Chief Promoted

Captain William A. Moffett on July 18 was named by President Harding to be Chief of the Navy Department's Bureau of Aeronautics.

He will take up his new duties with the rank of Rear Admiral.

Rear Admiral Moffett was previously Director of Naval Aviation, a title which apparently lapses with the constitution of the Bureau of Aeronautics.

Pulitzer Air Race Cancelled

Sidney D. Waldon President of the Detroit Aviation Society, on July 18 announced cancellation of the Pulitzer Trophy airplane race and contests for other trophies which the Detroit society was to have promoted here Sept. 8, 9, and 10.

Inability to get assurances from the Army and Navy Departments of service entries depended upon to provide competition in these events is given as the reason for the cancellation.

Army and Navy Order Lighter-than-Air Craft

An important order for lighter-than-air craft, comprising three airships and thirty-eight observation balloons, has just been placed by the lighter-than-air services of the Army and the Navy.

Two of the airships are ordered by the Navy and are to be completed by next spring. These ships belong to the D class (180,000 cu. ft., 240 hp., 56 m. p. h.)

The third airship will be of similar size, but of a new Goodyear design, and is to be completed for the Army in November. This ship will be 170 ft. long and 45 ft. in diameter, as against 198 ft. and 41.8 ft., respectively, for the naval D class. The power plant will be composed of two 125 hp. Aeromarine engines, which through a reduction gear will operate two propellers. The propellers will be driven through bevel gears at a two to one ratio, so that they will rotate at 800 r. p. m. The engines will be mounted in the car instead of in separate wing nacelles, and the transmission will be carried on outriggers. The engines will be fitted with clutches, which will permit their being reversed for landing. Either engine can drive both propellers in the event that one of the engines develops trouble. The position of the engines in the car will enable the mechanics to overhaul them much easier than if they were mounted on outriggers, as in the present types of our airships.

The car will be entirely enclosed and will house a crew of six, although three men will suffice for the operation of the airship in peace time pursuits.

The envelope will be much fatter than that of the D class airships and their shape will be similar to the Goodyear Pony Blimp, which has a fineness ratio of 3½.

The Army intends to use this new airship for border patrol, for which purpose stations are available at Arcadia, Fla., El Paso, and San Antonio, Tex. The two naval ships will be used for scouting and observation.

The designed speed of the new ship is 60 m. p. h. and the ceiling 10,000 ft.

The Flight of the Cloudster

The following particulars of the test flight and attempted trans-continental flight of the David-Douglas Cloudster are of interest. This machine was illustrated in the June 11th issue of AVIATION and AIRCRAFT JOURNAL. It was built by the Davis-Douglas Co. of Los Angeles who, however, had no connection with the late trans-continental attempt of the machine.

Saturday June 25th the Cloudster took off, flew and landed successfully at March Field, California with a gross weight of 9600 lbs. of which 5100 lbs. was useful load. The load consisted of two men, David R. Davis, owner of the machine and Eric Springer, pilot, 670 gall. of gasoline, 55 gall. of oil, 27 gall. of water and miscellaneous equipment such as parachutes, etc. Facts of interest in connection with the flight and adding to the accomplishment are the altitude of March Field, 1500 ft. above sea level, the fact that there was no air stirring to aid them in getting off, and the additional fact that the plane took off in less than 2500 ft.

Monday June 27th the Cloudster left March Field at 6 a. m. with the same load as on the 25th except that the gasoline supply had been reduced to 600 gall. The machine circled until an altitude of 2500 ft. above the field had been attained (altitude above sea level 4000 ft.) and then headed for El Centro in an attempt to make a non stop flight to the Atlantic Coast. Flying over the desert region of Arizona the machine encountered bumpy weather which tossed it about and then the barograph record of the flight shows drops of 500 ft. followed by slow climbing to regain altitude. The rough air brought on illness for the pilots and when they found themselves confronted by a storm in the vicinity of El Paso, Texas, they landed at Fort Bliss. They made a good landing but were hit by the combined hail and wind storm before they could get the machine in a hangar. The Cloudster was blown backwards resulting in damage to the tailskid bulkhead and the trailing edge of one wing. these parts are now being repaired and the trip will be attempted again, probably toward the end of July. The machine was in the air for 8 hrs. 45 min. and covered a total approximately 785 miles. Gasoline consumption averaged slightly less than 25 gall. an hour. An altitude of 8000 ft. was attained.

The service will readily find use for the airways and airports of the operation end. Certain of their accessories, notably the motor transport and work shops will also be requisitioned. The aircraft will be useful in supplementing what are now considered orthodox means of transportaion; but as far as combative service is concerned they will be useless. And this is just the point about which so many people who should know better are deluded. Replacing knowledge and reasoning with erratic imagining they visualize all manner of commercial aircraft, bereft of their proper appliances, hurling destruction on the enemy. Rather should they visualize the converted aircraft lumbering along to their destruction at the hands, or rather the guns, of fast pursuit machines from the carrier ships of the enemy fleet; which pursuit machines will have by this time penetrated the defenses of the commercial machines' escort because of the latter being handicapped by the antics of the former.

All of which is meant to prove that the success of our aircraft operations in war, and hence the safety of the country, will depend not on the convertibility for war purposes of commercial aircraft; but rather on the convertibility for war purposes of the industry which produces these aircraft. Furthermore, advances in aircraft design take place so rapidly that to put into production any particular types in times of peace is wasteful on account of the scrapping which must be done in the process of replacement.

Waste is relative. Procedures carried out in war would never be tolerated under peace conditions. The fact that they contribute to the successful prosecution of the war is their justification. The complaints about waste materialize when the danger of war has been removed. Hence it will be well to leave all scrapping of aircraft and replacements to war time, when they will surely be necessary; and so adjust the peace time program as to provide only sufficient of the advanced types of aircraft as will meet the requirements of experimentation and training.

It follows then that our aircraft policy should be such as to provide for extensive research work, and the consequent maintenance of a few of the advanced types of aircraft for testing and training purposes together with a skeleton organization under which these aircraft may at once be put into mass production by the commercial aircraft factories.

Under such a system there will be flexibility permitting of easy change with a minimum of waste, and preparedness supported by the resources of a vast industry.

The Lakehurst Naval Airship Station

The U. S. Navy Airship Hangar at Lakehurst, N. J. is the terminal for the airships which will be in use in this country within the next few months. It is 803 ft. long, 264 ft. wide and 190 ft. high. The doors at each end are 170 ft. high and are 264 ft. wide. Observation platforms on the roof command a view of the Atlantic seven miles distant. In another direction equally as far away Lakewood can be seen clearly; while in the vicinity the 1400 acre reservation is being cleared to provide workshops, shelter and transport facilities for the 800 enlisted men and 500 civilian employees who will man the hangar and care for the two airships.

The airships are the ZR-1 and ZR-2, the former being built at League Island Navy Yard, Phil., and the ZR-2 now undergoing trials in England. The hangar will be completed before the scheduled trans-Atlantic flight of the ZR-2 in August. The airships are each 700 ft. long and 85 ft. in diameter. Capt. W. A. Moffett, Chief of Naval Aviation, is of the opinion that commercial aviation will receive considerable impetus from the operation of the Navy dirigibles and their terminal. Accordingly, all preparations at the Lakehurst hangar are with a view toward establishing facilities and conducting experiments which will aid commercial transport, and at the same time, keep the public informed concerning the progress in the development of lighter than aircraft.

In addition to the great hangar, the Navy plans to erect a mooring mast to which the big airships may be moored. The mast will be so constructed that the giant ships will be moored bow on to the mast, and will swing in the direction of the wind. The Navy contemplates also the erection of other mooring masts throughout the country. These will be based on results of experiments with the Lakehurst mast.

Work was first started on the station in September, 1919. When Commander H. M. Eddy of the Bureau of Yards and Docks arrived at Lakehurst with his force of 800 men, he found a wilderness. They had to clear hundreds of acres and lay a branch railway to the main line before commencing work on the hangar. The tractor tanks used by the Marine Corps during the war were employed to pull stumps. Today the hangar is nearly completed and Captain Moffett has assigned Comm. R. D. Weyerbacher of the Bureau of Construction and Repair, and lighter than air expert for the Navy, to supervise preparations for receiving the ZR-2.

The doors of the hangar constitute the chief engineering problem. Each leaf is made up of 800 tons of steel and corrugated asbestos. There are two leaves on each end, opened by rolling parallel with the front of the shed. They are supported on concrete trucks which in turn rest on wheels, the size of those on a freight car. Similar trucks, set out from the doors and parallel to them, support huge steel girders braced against the top steel framework on the doors, and act as braces against winds which sweep through the shed. Like the doors, the entire siding of the shed is corrugated asbestos, arranged in strips alternating between gray and two shades of brown, so camouflaging the shed as to break up its outines and make it difficult for a hostile observer to locate it from the air.

In addition to a railroad running lengthwise through the hangar there are three trolley slots which are known as docking rails. The dirigible about to enter the hangar will be fastened by cable to these rails which extend on a 1500 ft. runway at either end. Anchored to the rails it will be a simple matter to guide the airship into its berth.

Up under the roof among the steel rafters, five monorail cranes support movable platforms which enable the workmen to repair the airship after it is housed. Suporting these rafters are nine trusses forming arches, arranged in pairs.

The roofs act as a resevoir, catching rain water which is stored in three tanks and used in the engine radiators. The windows in the sides and roof require individual motors to open them. The glass is amber-colored, to eliminate certain light rays, destructive to balloon fabrics.

The hangar is as fire-roof as possible. The concrete floor is covered with asphalt to prevent falling tools striking sparks and exploding the gas, and incidentially,to to maintain warmth. The heating is entirely beneath the floor, distributed through three tunnels. All wiring where possible is on the outside of the shed. The power plant is located some distance away, as is the gas plant which will have a daily capacity for manufacturing 75,000 cu. ft. of hydrogen, later to be increased to a hundred thousand cu. ft. capacity.

Search lights on two diagonal corners of the hangar will guide the dirgibles at night. On the other two corners are flood lights which will illuminate the field to the extent of 20 acres. Sunken lights arranged like crosses have been installed at the end of each runway, also to facilitate landings at night.

A twenty-five h. p. electric motor is used to open each leaf of the doors. It performs the work of men who would otherwise be employed at great loss of time. Navy men calculate that it will require just thirteen minutes to open the doors to receive a dirgible and approximately forty minutes for landing and housing it.

This terminal was built at a cost of between four and five million dollars, Capt. Frank T. Evans, son of "Fighting Bob" will be in command of the station.

Fiat 10 Passenger Airplane

The Fiat Co. has recently produced a 10-passenger airplane which embodies the results of long and minute studies of all details and devices, so as to ensure an almost perfect safety and a regularity of running incomparably superior to what has been obtained up to date. It is a big biplane with completely rigid body and central fuselage carrying the engine apparatus, the controlling cabin, the passenger cabin, the toilet closet, and all other installations required by modern comfort for a long journey. The airplane is shown on the annexed drawing.

The design of the airplane embodies the following features:

a. Three engine power plant apparatus driving one tractor propeller.

b. Good visibility for the pilot and ease of access to the power plant for the mechanic.

c. Comfortable passenger cabin with good visibility.

d. Fuselage of trellis-work covered with ply-wood ensuring a high factor of safety.

Structure of Wings and Fuselage

The wings are of the usual rigid spar type with lift balanced ailerons. The lower wing has 2 deg. dihedral and the upper wing an extension. The gap is 85 percent of the cord.

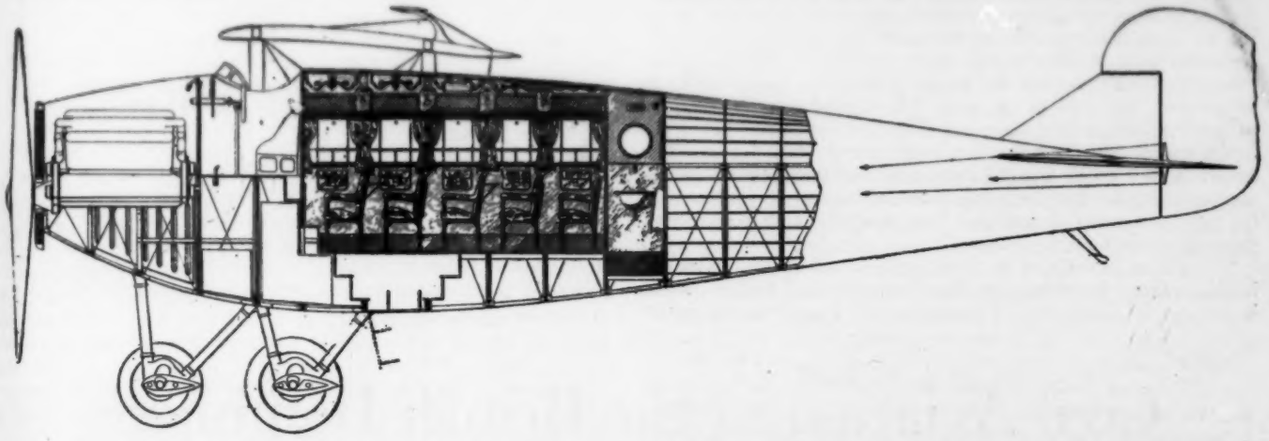
The fuselage is of trellis work covered with ply-wood which combines qualities of lightness, strength and minimum head resistance. All fittings are designed with a view to simplicity, strength and streamlining. As a result of the designing and workmanship a factor of safety of 8 has been attained.

Controls

Dual controls with an adjustable tail plane are provided. Simplicity of design in the control system has been aimed at.

Cockpit and Cabin

These have both been designed to give good visibility. The cockpit is located between the engine and the main planes, and connects with the cabin by means of a trap door. In the front



Cross-Sectional Diagram of the Fiat 10-Passenger Airplane, Showing the Arrangement of the Fuselage

e. Maximum speed over 125 m.p.h. minimum speed under 50 m.h.p.

f. Four-wheeled landing gear.

g. Balanced control surfaces and adjustable tail plane.

h.HighL/D ratio.

The Power Plant

The three engine power plant was adopted to avoid the dangers of engine failure in a single engine. The distribution of the power in units on the wings has been avoided. This system as practiced gives a higher propeller efficiency, but is the source of trouble due to the length of complicated pipings not always protected and easy to inspect, impossibility of inspection of the engines during flight, and small effect of the the slipstream on the tail plane. Besides these troubles another drawback to the multiple engine system driving multiple propellers is the fact that any lack of traction of a single propeller other than the central one causes a dangerous turning moment.

The three engine power plant aims to eliminate the disadvantages and retain the advantages of the division of the power plant into units. The three engines, by means of clutches, are automatically disengaged from, or engaged with, the propeller shaft. In this manner an engine giving trouble can receive attention during flight at the expense of reduced speed on the part of the whole machine.

Fuel and oil for 8 hr. are carried.

The stoppage of any one of the three engines results only in a decrease in the speed of the airplane which however cannot drop under 110 m.h.p., a decrease of only 14% of the maximum speed. In this manner a reserve of power is created to be called on when necessary.

of the cockpit is another trap door which gives access to the engines.

The cabin is roomy and comfortable, with five seats arranged down each side of a center aisle and with a toilet room aft.

Performance

The maximum speed of the machine is 125 m.h.p. and the ceiling 15,000 ft. The landing speed was not stated in the performance statistics.

Cadet Classes for Lighter-Than-Air Service

The regular course for cadets in lighter-than-air service in the Army Air Service will begin about Oct. 1. The cadets are to report on Sept. 25, and the course will end about Feb. 10, 1922, depending upon meteorological conditions. Those who successfully complete the course will be commissioned second lieutenants in the Air Service Officers' Reserve Corps, which grants them eligibility to take examinations for commissions in the Regular Army.

Proposed Air Mail Service

An act providing for the carrying of mail by airplane between Nassau, Bahamas and Miami, Fla. has passed its first reading in the Bahama House of Assembly. Certain concessions are granted to the Bermuda & West Atlantic Aviation Co., a British limited company with registered offices in London, and a subsidy of $25.000 a year is provided.

The Psychology of Passenger Carrying

Interesting views on the psychology of passenger carrying are expressed by Robert Gordon, who has for some time been associated with Edward Stinson in commercial aviation.

In the three years of his passenger carrying business Mr. Gordon has given 8,000 people flights without an accident. Speculation, then is interesting as to how many of these people would fly again when given the opportunity. In other words—having covered certain territory for passenger carrying, and had it pay, what are the chances of profit on returning to this territory? This involves an interesting study of crowd psychology, and in this conection Mr. Gordon says, "Anyone who has done any passenger carrying knows that the passenger just landed is the best advertisement to be had, for he, or she is enthusiastic and persuades friends to fly. This is true also for a return tour of the passenger carried as I have proved to my satisfaction.

"Last fall, before flying to Mount Kisco, N. Y., I communicated with the editor of the newspaper in that town, and as a result he was kind enough to feature my coming. I arrived in a Canuck, carried passengers for a day, and left in the evening to keep an engagement the next day at Liberty, N. Y. Last May Mr. Stinson and I were at Mitchell Field and to prove my theory we flew to Mount Kisco again and landed unannounced, this time in an Avro. We carried as many passengers as on the previous trip, and this minus newspaper publicity, and in face of news of a crash that created nationwide attention and which was the chief topic of conversation on the airdrome. Upon comparing my books of this trip with those of the previous one, I found that fully two thirds of the passengers were repeaters.

"As far as possible, I am keeping a record of all the places in the country that have been worked and, though this record is necessarily incomplete, I firmly believe that of the towns of at least 5000 inhabitants not more than 10 per cent of them have been visited by passenger carrying airplanes. Applying this ratio to the states, I find that in New York State alone there are approximately 35 towns of 5000 inhabitants which have not been worked. Furthermore, my records show that in towns of 5000 inhabitants one in every hundred will patronize a passenger carrying machine, while in cities of 20,000 the ratio is one in every two hundred.

"A feature conclusively proved is that on the second trip to any place a type of machine different from that used the first time will bring better results. This was illustrated in my trips to Mount Kisco—the very fact that the Avro differed from the Canuck, particularly in the feature of a rotary engine, made people anxious to ride. I asked many passengers why they were repeating the ride, and the answer invariably was to the effect that this was a new machine and hence they were anxious to try it. If that is so in Mount Kisco it is so elsewhere.

"I was recenty asked by the editor of a prominent aviation paper what the possibilities of the monoplane were in passenger carrying work. He knew that Mr. Stinson and myself had been experimenting with the new Sperry wing for attachment to Canucks. My reply to him was that the monoplane promises to do well as a passenger carrier. It has stability, maneuverability, visibility, and good load carrying capacity. Furthermore the absence of the lower wing is an advantage in "barnstorming" in that it increases the life of the machine because crowds cannot damage it by contact when the machine is on the ground. Another advantage of the monoplane is that its design is new to crowds and consequently attracts them. New types of machines and advance publicity are the keys to success in the passenger carrying work, and I am now planning another trip on this basis."

Civil Aviation in the British Dominions

A report on the progress of civil aviation during the period from Oct. 1, 1920, to March 31, 1921, recently issued by the British Air Ministry contains interesting information about the organization of civil aviation in various parts of the empire.

Information with respect to Canada is here omitted on account of its previous publication in AVIATION AND AIRCRAFT JOURNAL.

Australia.—The Air Navigation Bill was assented to on Dec. 2, 1920, and an Air Board has been established consisting of a Director of Intelligence and Organization, a Director of Personnel and Training, a Director of Equipment and a Finance Member. The Air Board is responsible to, and subject to the control of, an Air Council which comprises, under the presidency of the Minister of Defense, a naval member, a military member, two members of the Air Board, one nominated by the naval and one by the military member, and the Controller of Civil Aviation, who is directly responsible to the Minister of Defense. The principal function of the Air Council is to advise the Minister upon the general control of the Commonwealth's air policy in its naval and military aspects, and to coordinate civil aviation therewith.

Air Navigation Regulations were issued on Feb. 11, 1921, and three superintendents—*viz.*, of air craft, airdromes and flying operations, have been appointed to administer them.

The Cabinet has approved the operation of a Government air mail service by the Royal Australian Air Force, and the relative merits of two routes, Toowoomba-Winton and Geraldton-Derby, are being discussed.

Schemes are also under consideration for the establishment by private companies of regular air services between Sydney and Port Augusta (South Australia) and between Winton and Longreach (Queensland).

India.—The Air Board, which works under the Commerce Department of the Government of India and deals with questions of civil aviation arising in India, is a purely advisory body without executive functions. Owing to financial conditions in India it has not been found possible as yet to develop any trunk routes, but as soon as funds are available the Government of India has decided to prepare a main trunk route from Rangoon to Bombay, via Calcutta and Allahabad, attention being concentrated in the first instance on the preparation of the section between Calcutta and Rangoon. As soon as the route is completed, or a section of it, it is intended to call for tenders for an air mail service over the completed portion. The Government of India have also empowered local governments to lay out air routes within the boundaries of their own jurisdiction with the idea that subsidiary air routes will by this means be eventually established connecting with the Rangoon-Bombay trunk route.

The import duty on aircraft, aircraft engines and accessories has been reduced from 7½ per cent to 2½ per cent ad vaorem (not from 17½ per cent as stated in the last report).

New Zealand.—Air Regulations were published on March 18, under the Aviation Act of 1918. They are provisional pending the introduction of a new Act enabling effect to be given to the International Air Convention.

Contracts have been approved by the Cabinet for air mail services between Auckland and Whangarei, and between Christchurch and Timaru. Provision will be made for the carriage of passengers in addition to mails.

South Africa.—Pending legislation which is now being drafted, an Air Board has been appointed to advise the Government on air legislation and regulations, the development of aeronautics, proposals for the establishment of air mail and passenger services within the Union and between the Union and adjoining territories, and on all matters of general policy affecting civil aviation.

A New Aircraft Firm

The Cox-Kemlin Aircraft Corp. Inc., Consulting, Designing and Constructing Engineers, has recently been incorporated under the laws of the State of New York. The capital has been privately subscribed, the financial position of the company is sound, and the plant and the facilities are large enough to meet the present needs of the industry.

L. Charles Cox, President and General Manager has been interested in aircraft work for the last six years, having served three and one-half years in the Royal Flying Corps and the Royal Air Force. He was connected with the Lawson Aircraft Co. as Assistant to the President and as Chief Pilot. Later, he organized the Airliner Engineering Corp., which company constructed the twin-engined thirty passenger airliner which recently has made several flights at Hazelhurst Field. Mr. Cox was General Manager during the construction of this plane, which was built within five months, somewhat of a record for a machine of this size.

The Vice President and Chief Engineer is Alexander Klemin. The engineering organization of AlexanderKlemin & Associates has been taken over by the new company and has been transferred to the factory together with its library, engineering records, and files.

The Shop Superintendent is F. W. Vista, who has been for many years associated with the L. W. F. Engineering Co. as Assistant Shop Superintendent, and has had a large and varied experience in the construction of all types of aircraft.

The company has taken over a plant of the College Point Boat Corp., which during the war built H. S.-2 boats. This plant is fully equipped for the construction of aircraft on a small scale with excellent assembly, metal, wood and other shop facilities. The plant is situated at College Point, which is readily accessible to New York, and is right on Flushing Bay. The company has started construction on a number of passenger boats on private order, is bidding on government contracts, and is also offering its facilities for rebuilding and repairing of airplanes of every type and variety. The company is also offering the services of its engineering staff to transportation companies in planning air lines and in selecting suitable types of machines for their services. Assistance will also be given to inventors in engineering and constructional development.

A 4000-lb. Aircraft Bomb

The Ordinance Department of the Army is making plans for an aerial bomb to weigh 4,000 lb. which is very much larger than any bomb of the kind ever before conceived in the United States. It is to contain over fifty per cent. or 2,400 lb. of TNT, and will be one of the most deadly of all bombs known in modern warfare. Up to the present the largest bombs designed and constructed weigh but 2,000 lb. These already have been adopted as standard, together with bombs weighing 1,100 lb. 600 lb. 300 lb. and 100 lb. respectively, all of which contain about fifty per cent. of TNT. The new bombs weighing 4,000 lb. are to be used in connection with the largest bombing airplanes.

Navy Air Chief Promoted

Captain William A. Moffett on July 18 was named by President Harding to be Chief of the Navy Department's Bureau of Aeronautics.

He will take up his new duties with the rank of Rear Admiral.

Rear Admiral Moffett was previously Director of Naval Aviation, a title which apparently lapses with the constitution of the Bureau of Aeronautics.

Pulitzer Air Race Cancelled

Sidney D. Waldon President of the Detroit Aviation Society, on July 18 announced cancellation of the Pulitzer Trophy airplane race and contests for other trophies which the Detroit society was to have promoted here Sept. 8, 9, and 10.

Inability to get assurances from the Army and Navy Departments of service entries depended upon to provide competition in these events is given as the reason for the cancellation.

Army and Navy Order Lighter-than-Air Craft

An important order for lighter-than-air craft, comprising three airships and thirty-eight observation balloons, has just been placed by the lighter-than-air services of the Army and the Navy.

Two of the airships are ordered by the Navy and are to be completed by next spring. These ships belong to the D class (180,000 cu. ft., 240 hp., 56 m. p. h.)

The third airship will be of similar size, but of a new Goodyear design, and is to be completed for the Army in November. This ship will be 170 ft. long and 45 ft. in diameter, as against 198 ft. and 41.8 ft., respectively, for the naval D class. The power plant will be composed of two 125 hp. Aeromarine engines, which through a reduction gear will operate two propellers. The propellers will be driven through bevel gears at a two to one ratio, so that they will rotate at 800 r. p. m. The engines will be mounted in the car instead of in separate wing nacelles, and the transmission will be carried on outriggers. The engines will be fitted with clutches, which will permit their being reversed for landing. Either engine can drive both propellers in the event that one of the engines develops trouble. The position of the engines in the car will enable the mechanics to overhaul them much easier than if they were mounted on outriggers, as in the present types of our airships.

The car will be entirely enclosed and will house a crew of six, although three men will suffice for the operation of the airship in peace time pursuits.

The envelope will be much fatter than that of the D class airships and their shape will be similar to the Goodyear Pony Blimp, which has a fineness ratio of 3½.

The Army intends to use this new airship for border patrol, for which purpose stations are available at Arcadia, Fla., El Paso, and San Antonio, Tex. The two naval ships will be used for scouting and observation.

The designed speed of the new ship is 60 m. p. h. and the ceiling 10,000 ft.

The Flight of the Cloudster

The following particulars of the test flight and attempted trans-continental flight of the David-Douglas Cloudster are of interest. Thi machine was illustrated in the June 11th issue of AVIATION and AIRCRAFT JOURNAL. It was built by the Davis-Douglas Co. of Los Angeles who, however, had no connection with the late trans-continental attempt of the machine.

Saturday June 25th the Cloudster took off, flew and landed successfully at March Field, California with a gross weight of 9600 lbs. of which 5100 lbs. was useful load. The load consisted of two men, David R. Davis, owner of the machine and Eric Springer, pilot, 670 gall. of gasoline, 55 gall. of oil, 27 gall. of water and miscellaneous equipment such as parachutes, etc. Facts of interest in connection with the flight and adding to the accomplishment are the altitude of March Field, 1500 ft. above sea level, the fact that there was no air stirring to aid them in getting off, and the additional fact that the plane took off in less than 2500 ft.

Monday June 27th the Cloudster left March Field at 6 a. m. with the same load as on the 25th except that the gasoline supply had been reduced to 600 gall. The machine circled until an altitude of 2500 ft. above the field had been attained (altitude above sea level 4000 ft.) and then headed for El Centro in an attempt to make a non stop flight to the Atlantic Coast. Flying over the desert region of Arizona the machine encountered bumpy weather which tossed it about and then the barograph record of the flight shows drops of 500 ft. followed by slow climbing to regain altitude. The rough air brought on illness for the pilots and when they found themselves confronted by a storm in the vicinity of El Paso, Texas, they landed at Fort Bliss. They made a good landing but were hit by the combined hail and wind storm before they could get the machine in a hangar. The Cloudster was blown backwards resulting in damage to the tailskid bulkhead and the trailing edge of one wing. these parts are now being repaired and the trip will be attempted again, probably toward the end of July. The machine was in the air for 8 hrs. 45 min. and covered a total approximately 785 miles. Gasoline consumption averaged slightly less than 25 gall. an hour. An altitude of 8000 ft. was attained.

Trade Notes

Two interesting new devices which are manufactured by the American Instrument Co., of Washington, D. C., have just come to our attention. One is the Newell Check Valve Compression Indicator. This was originally designed by Mr. F. B. Newell of the U. S. Bureau of Standards, to get an accurate measure of the maximum compression in internal combustion engines. This is obtained by a very sensitive needle check valve which closes as soon as a pressure starts to decrease, hence insuring the maximum pressure reading on the gauge.

The other device is a High Speed Pressure Indicator which consists essentially of three parts. A pressure balancing element, a timing element and a coordinating element.

(1) The pressure balancing element is the part communicating with the engine cylinder and is used to balance the cylinder pressure by a controllable and measurable static gas pressure and to indicate electrically when this condition of balance exists.

(2) The timing element which is fastened to a revolving part of the engine contains a revolving contact of one degree duration and a brush which can be set at any selected piston position in the cycle and is used to close the indicator circuit at a predetermined instant. It has incorporated into its construction, a rotating spark gap, to be connected in series with the firing circuit by which the angular position of the firing spark may be located and with which interesting data on faulty ignition may be obtained.

(3) The coordinating outfit consits of two parts, (a) the electric circuit, and (b) the pressure circuit. The former is made up of a series connection of battery, telephone receivers, timer, and indicator. The latter consists of a source of gas under pressure and a source of partial vacuum with valves and gauges for supplying, controlling and measuring the balancing pressure.

The indicator is now being used successfully in the test laboratories of many of the automotive factories and educational institutions throughout the country. Complete descriptions of the two above mentioned devices may be obtained in pamphlets issued by the company.

Flexible Fuel Pipes

Though no doubt permanently fixed steel piping for gasoline and oil systems in aircraft is preferable to copper piping, nevertheless rigid piping of any kind is liable to fracture by vibration, or to damage by careless workmen, or by accident, when work is being done on other parts of the machine. Obviously flexible piping is preferable to any kind of rigid piping if a satisfactory flexible pipe which is gasoline, oil and water proof can be had.

Hitherto the right kind of pipe has been lacking—at any rate since the Bowden flexible pipe was abandoned—or else, where a satisfactory pipe has been found it has been impossible to discover a trustworthy joint for it. These difficulties seem to have been overcome by the Blaisdell Petro-Flex Tubing Co. Ltd. of England.

The pipe itself is composed of an inner layer of gut—either pig, ox, or horse—strengthened by canvas and protected from external pressure by wire winding. Animal gut is found to be proof against gasoline, oil, and water. Canvas is the best strengthening material, and wire is the best anti-crush material.

Educating the Public

The following news item, which appeared in the Harrisburg, Pa., *Telegraph*, does not require any comment.

Middletown, Pa., July 7.—The large airplane which arrived at the Aviation Station on Tuesday from Langley Field, Va., left yesterday afternoon on the return trip. The machine is a Martin-Balmer type. It has two motors and seats twelve persons. When it arrived here it carried six men. The large plane was accompanied here by smaller machines, also of Martin-Balmer make. The large machine is a mail plane. It returned to Langley Fields with a supply of airplane goods. The machine measures seventy-two feet from wing to wing and is 100 feet long.

Where to Fly

CALIFORNIA
SAN FRANCISCO, CALIFORNIA
EARL P. COOPER AIRPLANE & MOTOR CO.

ILLINOIS
CHECKERBOARD AIRPLANE SERVICE
FOREST PARK, ILLINOIS

INDIANIA
One of the largest and best equipped flying fields in the United States.
CURTISS-INDIANA COMPANY
Kokomo, Indiana
ALL TYPES OF CURTISS PLANES.

LOUISIANA
GULF STATES AIRCRAFT COMPANY
SHREVEPORT, LA.

MASSACHUSETTS
BOSTON AND SPRINGFIELD, MASS.
EASTERN AIRCRAFT CORP.
340 FIRST ST., BOSTON, MASS.

MINNESOTA
WHITE BEAR LAKE, MINN.
The Twin Cities' chief summer resort.
Harold G. Peterson Aircraft Company
SCHOOL OF AVIATION

NEW YORK
AEROMARINE AIRWAYS, INC.
Times Building, New York
11 Passenger Flying Cruisers -- 5 passenger, open and enclosed Flying Boats. Sightseeing Tours - Flights to Shore and Lake Resorts

NEW YORK & NEW JERSEY
CURTISS FIELD, GARDEN CITY, LONG ISLAND
KENILWORTH FIELD, BUFFALO, N. Y.
FYING STATION, ATLANTIC CITY, N. J.
CURTISS AEROPLANE & MOTOR CORPORATION

OHIO
DAYTON, OHIO.
Supplies, Hangars, Shops and Field 1 Mile from Dayton limits.
JOHNSON AIRPLANE & SUPPLY CO.

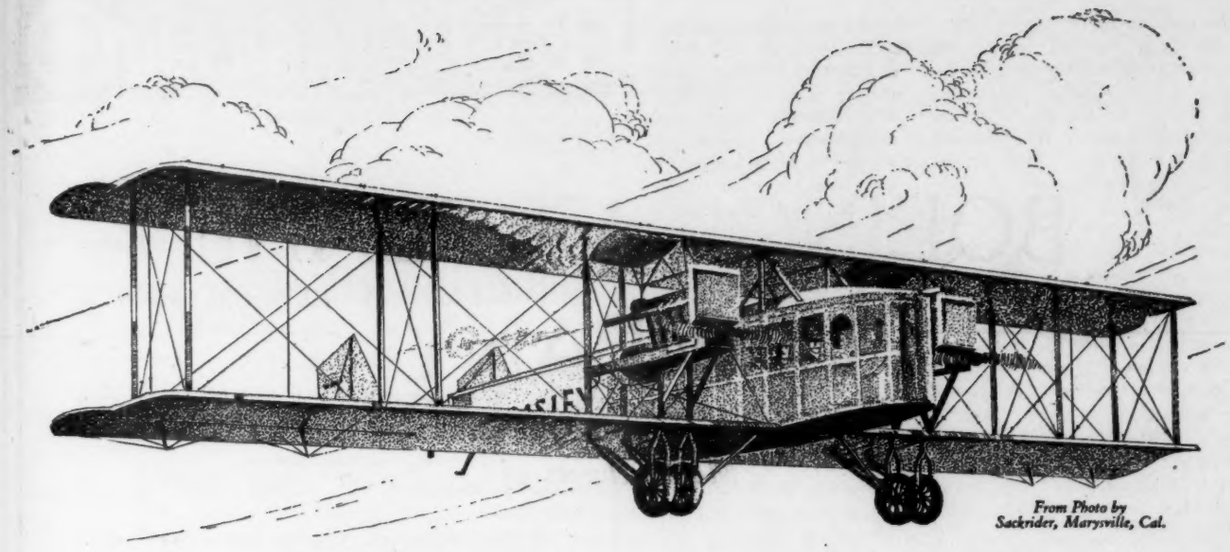
OREGON
LAND OR WATER FLYING
OREGON, WASHINGTON AND IDAHO AIRPLANE COMPANY
PORTLAND, OREGON

PENNSYLVANIA
Flying School and Commercial Aviation
Send for Circular
Official Flying field Aero Club of Pennsylvania
PHILADELPHIA AERO-SERVICE CORPORATION
636 Real Estate Trust Building, Philadelphia.

WISCONSIN
CURTISS-WISCONSIN AEROPLANE CO.
FLYING SCHOOL
Milwaukee Air Port
GILLES E. MEISENHEIMER
330 Clinton Street Milwaukee, Wis.

If you are one of the companies in your state having first class facilities for passenger carrying, pilots' training and special flights, you should be represented in WHERE TO FLY each week.

26 Consecutive Insertions $20.00



From Photo by Sackrider, Marysville, Cal.

The Friesley Falcon—

One of the finest of our modern Airliners is the Friesley "Falcon." Built specially for passenger service, the "Falcon" carries twelve passengers and baggage in her comfortably furnished and enclosed cabin, at a speed of 120 miles an hour.

Mr. B. M. Spencer, designer and builder of the "Falcon," writes ". . . . . when the question of varnish came up there was no hesitation as to what to use. Valspar is used by preference on all our ships and always has given complete satisfaction. Due to the fact that the ship was varnished under the worst possible conditions—heavy rains and in a building exposed to the weather—the behavior of Valspar was simply wonderful."

Today Valspar is everywhere recognized as the ideal varnish for airplane use. Valspar is proof against weather, water and wear—against rain and sun, oil, gasoline and grease. And it is so wonderfully elastic and tough that the severest vibration will never cause it to crack.

VALENTINE'S VALSPAR
The Varnish That Won't Turn White

VALENTINE & COMPANY
Largest Manufacturers of High-grade Varnishes in the World
ESTABLISHED 1832
New York Chicago Boston Toronto
London Paris Amsterdam
W. P. FULLER & CO., Pacific Coast

BOEING AIRPLANE COMPANY

Manufacturers of

EXCLUSIVELY DESIGNED

SEAPLANES

FLYING BOATS

AIRPLANES

CONTRACTORS TO UNITED STATES GOVERNMENT

GEORGETOWN STATION

SEATTLE WASHINGTON

Member of the Manufacturers Aircraft Association.

The Laird Swallow

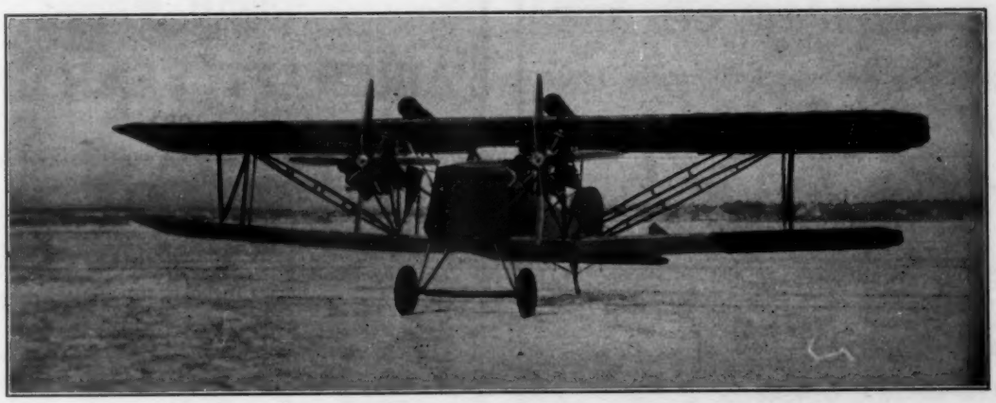
"America's First Commercial Airplane"

EXPERIENCED pilots note at once from the specifications of the Laird "Swallow" its remarkably light weight, low horse-power and small dimensions, as compared with its large carrying capacity and proved splendid performance. The resultant low operating cost is the goal of every company or individual operating airplane passenger or freight for profit. "Swallow" Distributor Franchises are paying well – some yet to be awarded.

E. M. LAIRD COMPANY

MANUFACTURERS
WICHITA, KANSAS
General Sales Offices
2216 SO. MICHIGAN AVE., CHICAGO.

E. M. Laird Company,
2216 So. Michigan Ave., Chicago, Ill.
Please send the undersigned a copy of your new booklet on The Laird "Swallow"
Name .....
Address .....
.....



THE EARLY BIRD (HD-1 B)

OUR AIRPLANES ARE PRODUCED BY MEN EXPERIENCED IN THE DESIGN AND CONSTRUCTION OF COMMERCIAL AND WAR TIME AIRCRAFT OF ALL TYPES

Type	Weight Full Load	Useful Load	Motors	Number of Motors and H.P.	Lbs. per H.P.	Lbs. per sq. ft.	Selling price without motor	Selling price with motor
HD-1B	2850	5 seats 1100 lbs.	10 cyl. Anzani	2-100 200	14.1	6.5	$4,500.	$5,700.
HD-4B	1940	2 or 3 seats 740 lbs.	10 cyl. Anzani	1-100 100	19.4	5.8	$4,200.	$4,800.

HUFF, DALAND & CO., INC.

OGDENSBURG, NEW YORK

AIRPLANES FLYING BOATS MOTOR BOATS

Cox-Klemin Aircraft Corporation

Consulting, Designing & Constructing Engineers

College Point, Long Island, N. Y.

Flushing 1800

has established a fully equipped plant for the experimental construction of aircraft

has taken over the engineering organization of Alexander Klemin & Associates

will undertake the design and construction of special airplanes of every type and for every purpose

will render consulting service to Transportation Companies in laying out airways and selecting ships

will re-build and repair airplanes of every type

HEATH AIRPLANE CO., INC.

America's Oldest Aeronautical Supply House

Est. 1909.

Tremendous Cut in Prices

FOR AUGUST

Dope	$ 1.70
Airplane cloth	.39
Shock absorber	.10
Cable	2.75
Cable thimbles	1.50
Standard J1 and JN fuselage fittings, each	1.00
Tachometers	10.00
Propellers for Curtiss, Hall-Scott or Hispano	18.00

Send for our August Price List

HEATH AIRPLANE CO., INC.

2856 Broadway, Chicago, Ill.

AIRCRAFT YEAR BOOK

1921

Aeronautics—The most talked of element to-day in Commerce and national defence

INTERNATIONAL Edition of the Aircraft Year Book just off the press—360 pages—275 text and reference data, 38 illustrations, 47 historical aircraft designs, maps, etc.

This book tells you what you should know concerning flying in all its phases, transport of passengers and packages, mail, forest patrol, fishery work, photography, world records, law, airports—military and naval developments.

The edition is limited. Sign and return the attached blank to-day. Published by

MANUFACTURERS AIRCRAFT ASSOCIATION, INC.

Fill in and return order blank with remittance.

The GARDNER, MOFFAT CO.
225 Fourth Ave., New York.

Gentlemen:

I enclose check (or) money order (please indicate which) for.....for which please send me postpaid .....copies of the 1921 Aircraft Year Book at $3.20 each, postpaid.

(please print) *Name*.....

E *Address*.....

INDEX TO ADVERTISERS

A

Aero Import Corp..... 151
Aeromarine Plane & Motor Co..... 124
Aircraft Materials Equipment Corp..... 149
Aircraft Service Directory..... 150
American Airways 149

B

B. G. Corporation 149
Boeing Airplane Co..... 144

C

Cox-Klemin Aircraft Corp..... 146
Curtiss Aeroplane & Motor Corp..... 123

D

Dayton Wright Co..... 122
Diggins, Ralph C., Co..... 149

F

Flottorp Manufacturing Co..... 149

H

Huff, Daland & Co., Inc..... 145

L

Laird, E. M., Co..... 145

M

Martin, The Glenn L., Co..... 152

N

Navy Department..... 147

R

Roebling's, John A., Son's Co..... 149

S

Sperry, Lawrence, Aircraft Co., Inc..... 146

T

Thomas-Morse Aircraft Corp..... 125

V

Valentine & Co..... 145

W

Wellington, Sears & Co..... 149
Where to Fly..... 142
Wright Aeronautical Corp..... 126

BUY IT FROM THE NAVY

AERONAUTICAL EQUIPMENT

The following listed material is being sold by the Navy Department. The larger part of it is new and unused. This is a great opportunity. Take advantage of the low prices. Catalogs will be sent on request.

AEROMARINE 39-B SEAPLANES
CURTISS M F FLYING BOATS.
STANDARD SCOUT AIRPLANES.
BOEING SEAPLANES
OVERHAULED BURGESS N-9 SEAPLANES
MODEL F FLYING BOATS.

KITE BALLOONS

LIBERTY ENGINES
CURTISS "OX" 90 HP AND "OXX" 100 HP ENGINES
CURTISS "OXX-6" 100 HP ENGINES
CURTISS V-2, TEN 200 HP 8 CYLINDER ENGINES
HALL-SCOTT A-7-A 100 HP 4 CYLINDER ENGINES
GNOME 100 HP ENGINES

RADIATORS, VARIOUS TYPES $5.-$15.
TANKS, VARIOUS TYPES $5.-$10.
TACHOMETERS $8.
ALTIMETERS $15.-$50.
PROPELLORS $5.-$15.
COMPLETE SETS CONTROL WIRES, VARIOUS TYPES 1/3 COST
AEROPLANE FABRIC, COTTON AND LINEN

BUREAU OF SUPPLIES AND ACCOUNTS

NAVY DEPARTMENT WASHINGTON, D. C.
Sales Rooms Bldg. 176 Navy Yard
Washington, D. C.

The President Has Announced

A POLICY
OF ENCOURAGEMENT OF MILITARY AND CIVIL AVIATION

There is now every reason to anticipate immediate progress in building up the Army, Navy, Postal and other Government air services. Large orders have already been placed. Civil aviation also will be fostered by national legislation and the development of landing fields and airdromes will have Government encouragement.

IT WILL PAY YOU TO KEEP CLOSELY IN TOUCH WITH THESE DEVELOPMENTS AND COMPLETE TECHNICAL DETAILS BY READING EACH WEEK THE RECOGNIZED AMERICAN AUTHORITY ON AERONAUTICS –

Sign the coupon now but do not send any money with it. We will send you the next two issues as they appear and bill you for a year's or six month's subscription, as you prefer. If, upon receipt of bill, you decide not to continue, advise us promptly and accept the two issues with our compliments.

Aviation and Aircraft Journal

GARDNER, MOFFAT CO., INC.,
225 Fourth Ave., New York.

Send me the next two weekly issues of AVIATION AND AIRCRAFT JOURNAL. If, upon receipt of bill for subscription as indicated below, I decide not to continue, I will so advise you, and understand that no charge will be made for the two copies.

One Year (52 issues – U. S. $4.00; Canada $5.00; Foreign $6.00)
Six Mos. (26 issues – U. S. $2.00; Canada $2.50; Foreign $3.00)

Name .....

Address .....

.....

COMMERCE CALLS FOR SPEED
FLYING IS THE ANSWER

LEARN TO FLY!

IN CHICAGO WITH

THE RALPH C. DIGGINS CO.

YOU start flying the day you arrive. Competent Instructors. Newest Types of Planes. Gosport System of Instruction.

Thorough Ground Course, including instruction in motors, plane-assembly, wireless, navigation, cross-country flying, field management. Living quarters right here on the field.

PILOTS Receive $5000 Per Year and Up

ENROLL NOW!

Write for literature and enrollment offer.

THE RALPH C. DIGGINS CO.

Dept. 205. 140 N. Dearborn Street Chicago, Ill.

Aerial Garage

THE AMERICAN AIRWAYS announce that their hangars, located on College Point, Flushing, (N. Y. City), are equipped to handle any kind of airplane or seaplane job of

OVERHAUL REPAIR

CONSTRUCTION

SALVAGING TESTING

and that a full supply of spares and materials is always to be had at reasonable prices.

For further information:
Vanderbilt 4792 or
Flushing 1800

AMERICAN AIRWAYS

College Point New York City

W. G. Schauffler, Jr. Hugh D. McKay T. L. Tibbs

Operating: American Airways Training Schools for Air Mechanics and Pilots.

Expert Pilots and Mechanics on short notice

The Spark Plug That Cleans Itself

B. G.

Contractors to the U. S. Army Air Service & the U. S. Navy

THE B. G. CORPORATION

33 GOLD STREET

NEW YORK CITY U. S. A.

CANUCK

AND

OX5 ENGINE SPARE PARTS

IMMEDIATE DELIVERY

C.A.L. PROPS. $15 PARAGON PROPS. $30

ROME - TURNEY RADIATORS $20

ALSO COMPLETE ASSORTMENT OF STANDARD UTILITY PARTS

GET OUR PRICES BEFORE ORDERING

AIRCRAFT MATERIALS & EQUIP. CORP.

1409 SEDGWICK AVE., NEW YORK CITY

ROEBLING

19 Wire Galvanized Aircraft Strand—Sizes 1/2" - 1/16"
Standard Tinned Aircraft Wire. B & S. 0 - 24
6 x 7 (Cotton Center) Galvanized Aircraft Cord 1/2" - 1/16"
7 x7 (Wire Center) Galvanized Aircraft Cord 1/2" - 1/16"
7 x 19 Tinned Aircraft Cord 1/2" - 1/8"
Standard Galvanized Steel Aircraft Thimbles 1/2" - 1/16"
Standard Steel Aircraft Ferrules. B & S No. 6 - 20

JOHN A. ROEBLING'S SONS COMPANY

TRENTON, NEW JERSEY.

Flottorp Manufacturing Co.

AIRCRAFT PROPELLERS

Established 1912

213 Lyon St., Grand Rapids, Michigan

Contractors to United States Government

Warwick **NON-TEAR** *Aero-Cloth*

A SAFE CLOTH *for* FLYING

For Particulars Apply to

WELLINGTON SEARS & CO.

66 Worth Street, New York

The Aircraft Service Directory

WHERE TO PROCURE EQUIPMENT AND SERVICES

SPERRY AIRPLANE INSTRUMENTS USED ALL OVER THE WORLD

THE LAWRENCE SPERRY AIRCRAFT CO., INC.
Farmingdale, Long Island, New York
Phone: Farmingdale 133

WANTED — AIRPLANE AND CAMERA
service in every part of the states. Ask for our questionnaire and plan to build nation-wide aerial photographic service.
We find it necessary to meet the demands of national advertisers and desire to use your equipment as far as possible.
FAIRCHILD AERIAL CAMERA CORPORATION
136 West 52nd Street New York City

CANUCK OX5
Complete stock of inspected materials, parts and instruments at specially reduced prices. Write for list. New AVROS and CANUCKS at bargain-prices.
Lowest prices and promptest service in U. S.
JAMES LEVY AIRCRAFT CO.
2043 INDIANA AVENUE CHICAGO, ILL.

PRICED FOR A QUICK SALE
One Lincoln Standard Tourabout with Detachable Enclosed Cabin . . . . . $3,900.
One Lincoln Standard Speedster . . . . . $3,900.
These planes are in splendid condition Motor 150 H.P. American Hispano just overhauled.
One Canuck now being rebuilt completely . . . . $1,600.
HAMILTON AERO MFG. CO. Milwaukee, Wis.

Speed & Drift Indicator
WRITE FOR INFORMATION
PIONEER INSTRUMENT COMPANY
136 Havemeyer Street Brooklyn N Y

ANOTHER JN-4D REDUCTION!
TWO NEW SHIPS ..... $2750 ea.
THREE REBUILT SHIPS ..... $1500 ea.
QUOTED SUBJECT TO PRIOR SALE
CURTISS EASTERN AIRPLANE CORP.
130 So. 15th Street, Philadelphia, Pa.

WRITE FOR OUR SPECIAL PRICE LIST
CANUCK, JN., AVRO AND OX-5 PARTS
ERICSON AIRCRAFT LIMITED
120 KING ST., EAST, TORONTO, CANADA

CONSULTING AERONAUTICAL ENGINEERS
AN INDEPENDENT ORGANIZATION OF SPECIALIZED AERONAUTICAL ENGINEERS
ALEXANDER KLEMIN & ASSOCIATES
22 East 17th Street New York

VAN MUFFLING & MARX
CONSULTING AERONAUTICAL and AUTOMOTIVE ENGINEERS
Members of the Faculty, College of the City of New York
Research and Reports Design and Development
299 Madison Avenue, cor. 41st Street, New York City

NOW READY FOR DELIVERY
AIRCRAFT YEAR BOOK
1921
GARDNER, MOFFAT CO. INC.
225 Fourth Ave. New York

CANUCK
THE UNIVERSAL PLANE
PRICE NEW $3000 F.O.B. BALTIMORE OR AERODROME
PROMPT SERVICE
FROM OUR COMPLETE STOCK OF CANUCK AND OX5 PARTS
AMERICAN AIRCRAFT
AERODROME INCORPORATED STORES
LOGAN FIELD, MD. BALTIMORE, MD. DUNDALK, MD.
STATION F. BOX 104

Ex-Pilot U. S. Air Service
U. S. and Foreign Patents and Trademarks
ALLEN E. PECK
Patent Attorney
29-31 Pacific Building, 622 F. Street, N. W.
WASHINGTON, D. C.

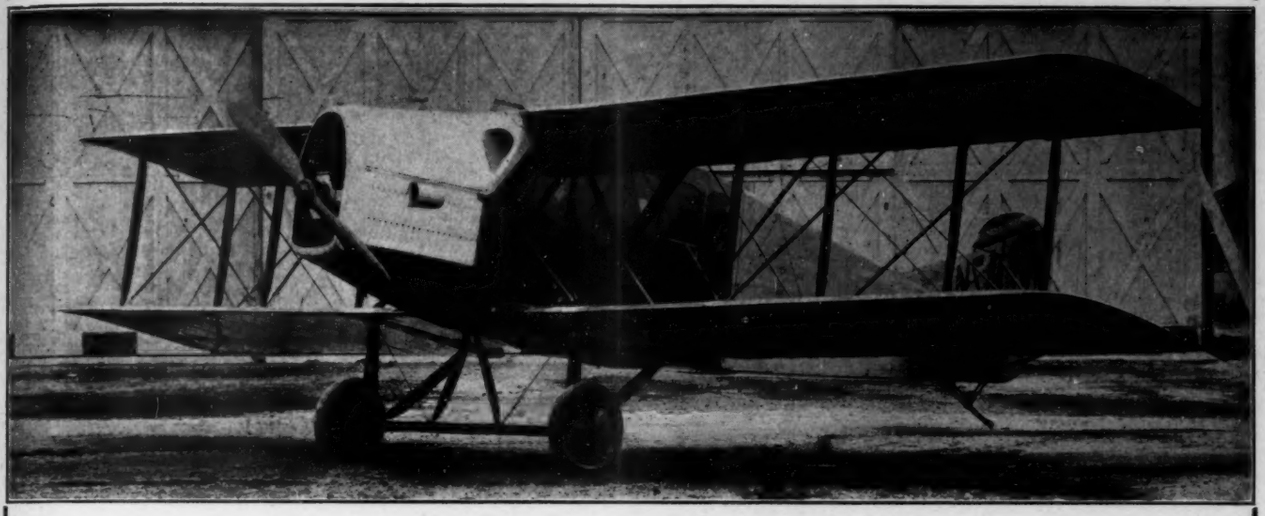
AN OPPORTUNITY TO COMPLETE YOUR FILES
We have a limited supply of bound and unbound volumes, also a few back issues of
AVIATION AND AIRCRAFT JOURNAL
225 FOURTH AVE. NEW YORK CITY

WRITE for INFORMATION
About this Directory Advertising
IT'S BRINGING RESULTS

MADE IN ITALY--USED THROUGHOUT THE WORLD

Ansaldo S. V. A. Aeroplanes

Reliability—Speed—Economy



ANSALDO SIX PLACE AERIAL TRANSPORT MODEL A300C

ANSALDO DISTRIBUTORS

WYOMING, NEW MEXICO, UTAH, COLORADO	HUMPHREYS AIRPLANE COMPANY	FIRST NATIONAL BANK BLDG. DENVER, COL.
TEXAS, OKLAHOMA, MISSOURI	C. B. WRIGHTSMAN	KENNEDY BLDG. TULSA, OKLA.
KANSAS	E. C. MORRIS	ARKANSAS CITY, KANSAS
INDIANA, ILLINOIS, WISCONSIN	RALPH C. DIGGINS	140 N. DEARBORN ST. CHICAGO

FOR DEMONSTRATIONS, SALES AND SERVICE IN THE ABOVE TERRITORY APPLY TO OUR DISTRIBUTORS

LIST PRICES F.O.B. NEW YORK

MODEL NINE	-	TWO PLACE -	$ 5950.00
	-	THREE PLACE -	$ 6200.00
MODEL A300 3	-	THREE PLACE -	$ 9500.00
MODEL A300 C	-	SIX PLACE -	$13000.00

AERO IMPORT CORPORATION

1819 BROADWAY - - - - NEW YORK

WRIGHT PATENTS LICENSEE

A Thousand to One

BUILT on what war taught—the entire plant of The Glenn L. Martin Company, in Cleveland, is planned for quick expansion at sudden call.

The Company laid out grounds—located buildings—designed special tools and trained its personnel—with one objective, rapid production of *quality* aircraft.

Every eight days, a finished Martin Bomber is turned out.

If war comes the Company can shortly reach a production of ten a day.

1000 Martin Bombers can be built for the cost of a modern battleship with its accessories.

What chance would one ship have against 1000 bombers?

What chance would a man armed with a rifle have, attacked by 1000 hornets each carrying a fatal sting?

Think it over!

THE GLENN L. MARTIN CO.

CLEVELAND

Member of the Manufacturers Aircraft Association

TRADE-MARK

TRADE-MARK